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A NOTABLE CONVENTION

The promise of the program for the Newark Convention of the American Society of Municipal Improvements, outlined under the same title in this department last month, was fulfilled completely, and practically every one left with words of commendation for the wealth of valuable papers and interesting discussions and the good care taken of the delegates by the local committees. The discussion of the valuable papers on sewage disposal was cut short by an eleventh hour demand for the convention hall for other purposes, but the papers themselves were most of them printed in the advance papers and covered all the work done during the past year and the answering of questions was the only necessary omission. Much of this was done in smaller group meetings later in the day.

Unexpected contests over proposed changes in specifications took time from presentation of routine papers on paving, but every one seemed pleased with the result and after lively discussions the Association reasserted its unvarying position regarding the manner of adopting changes in specifications and the revisions will be found as usual only those in details necessary to keep the specifications in close accord with the latest tested and approved methods of construction.

There was but one real exception to these general expressions of satisfaction with the convention, for the as yet unexplained habit of the *Engineering Record* of objecting to the methods and results of the modes of procedure of the Society led it into some criticisms of the Society's actions, which became so hysterical that they actually condemn the Society for doing just what the *Record* has demanded it should do, losing sight of the fact that its criticisms are applicable to the things the Society was asked to do and that the refusal of the Society to accede to these requests should be commended if the *Record* is to gain a reputation for consistency.

The Society is certainly alive and growing in importance and influence and attacks so obviously ill-informed and worse conceived seem to have the effect of making the value and high standing of the Society better known and the desire for membership in it more extended.

STATE HIGHWAY CONDITIONS.

Recent travel over representative sections of the highways of four states with highway commissions, with less detailed observation of roads in three other states, gives material sustaining the positions taken by MUNICIPAL ENGINEERING relative to the character of design and construction required for the most economical administration of the public highways.

The travel included bituminous and other pavements in the states early in the highway construction field, such as New Jersey and New York, where such road surfaces are becoming unbearably expensive to maintain, after some years of use, because the traffic has changed so in character and amount that pavements sufficient at the time of construction are now wholly inadequate except as foundations for more durable wearing surfaces. The fact that they are built with the proceeds of 20 or 50-year bonds makes no difference, but only demonstrates the folly of making bond terms longer than the estimated length of life of the roads, and the bad judgment of the designers in estimating the effect of road improvement upon the amount and weight of traffic over such improved roads. If the New Jersey estimates, that the tonnage capacity of motor trucks running on country roads is equal to the railroad tonnage capacity, are discounted even fifty per cent, the absolute necessity of providing for such enormous traffic in designing and constructing a new road is fully demonstrated. No traffic regulations should be permitted to dwarf such a development, tho such details as excessive weights, narrow tires, kind of tires and speeds in proper relations to each other are necessary to the permanence of even the most durable pavements.

The travel in Michigan showed that the small amount of state aid granted in that state has the effect of improving gradients, widths of roads and drainage facilities, and to a certain extent the quality of materials on the roads, but is not sufficient to develop the use of modern road surfaces. The result is good as far as it goes, but the main traveled roads are frequently impassable, because the traffic now running over them wears them out annually or biennally, and the state must reconstruct road surfaces on such roads before it can be said to have a real highway system. A few wealthy counties are doing their full duty in this regard, but the state at large is with reasonable speed putting itself into the condition of Indiana. In that state the local roads are excellent and in the main sufficient for the traffic over them, but the main traveled roads, built of the same gravel or light macadam, are either impassable at a reasonable speed most of the time or are practically reconstructed every year.

Travel in Illinois, Ohio and Pennsylvania showed the effects of designing the main traveled roads for the travel expected over them, and in these states most of the roads now building need not be reconstructed for many years and will require only incidental repairs if very reasonable regulations of trailers and of relation of speed to load are enforced, such as are now proposed in New Jersey.

State supervision of main highway construction and maintenance and state and national aid in liberal amounts on the trunk lines are fully demonstrated by the facts gathered on these trips to be necessities of modern traffic conditions.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE MAINTENANCE OF BRICK PAVEMENTS

Written and Compiled by the Editor

Maintenance of pavements is a subject which has never received the attention it deserves and there is practically nothing in print upon the subject. There has been no attempt at standardization of methods, determination of economics of repair or of neglect of repair nor of keeping cost data. The repair of streets is generally assigned to one of the less technical departments of the municipal administration and one which is subject to frequent changes in personnel on account of the demands of city politics. This doubtless accounts in large part for the unsatisfactory state of enlightenment of the average city government upon this important problem of municipal housekeeping. Fortunately, there are a few of the large cities in which, at least occasionally, the maintenance of streets is in competent hands and there is a little foundation on which to base an article such as this.

As to actual methods used in the repair of streets it is only possible in a single article to describe one or two of those producing the best results. The absence of any written discussions of the economics of street maintenance makes it necessary to devote much of the article to this subject, making it of as much practical benefit to the street superintendent as possible.

Resurfacing being one method of maintaining an old brick street, one or two methods of performing this work are given.

Undoubtedly some of our readers have devised special methods for brick street repair, others have figures of actual cost, and others have studied the question of when to repair a brick street in order to keep it in good condition for the least expense, and we hope to hear from all of them with additional information and in criticism of this article. City administrations need more help on the problems of street repair than in any other branch of construction and city officials are invited to contribute from their own stores of information for the benefit of the officials in other cities.

A BRICK pavement properly designed and constructed for the traffic to which it will be subjected is practically indestructible, and for such a pavement there is no maintenance required. Such a pavement is an ideal, however, which is seldom realized, so that every brick pavement will require at least slight repairs from time to time. Whether defects appearing shall be repaired or not, and if repaired, when, are questions which this article will discuss to some extent, giving experiences of those expert in their answer.

Soft Bricks.

The simplest defect appearing in a brick pavement is the soft brick. When such a brick is subjected to traffic it will wear faster than the surrounding bricks, and soon a depression is formed which brings the wear upon the surrounding bricks so that they receive greater punishment from the blows of the traffic dropping ever so slightly into the depression and therefore wear more rapidly than their fellows, and the hole rapidly increases in size and depth. When such a soft brick shows itself it should be cut out and replaced promptly with a new one. Every day's delay causes greater wear of the bricks surrounding it and makes more necessary the replacing of such bricks in order to make the repaired surface uniform with the pavement surface surrounding it. If the bricks in the pavement, all of them, have a high loss in the abrasion test, the repair must be made more promptly than if the bricks in general are hard. If traffic is light, a week or a month of delay may not count for more than a day on a heavy-traffic street.

To make such a repair the brick must be cut out, meaning its entire destruction, with chisel and hammer; the joints surrounding it must be cleaned out, the sand cushion must be carefully removed, renewed and compacted. The sand must be adjusted so that the top surface of the brick will be exactly even with the pavement surface surrounding it, and the brick must be removed and replaced as often as necessary to bring this result. No sand should be permitted to work up into the joints. Then the joints surrounding the brick must be completely filled until the surface is brought to its original smooth condition.

Monolithic brick pavements are yet too new to have required repairs, but it would seem that it might be necessary, in replacing a soft brick, to cut out the foundation somewhat to allow for the adjustment of the surface to perfect alinement. Sand-cement mortar would be used as the material in which to bed the brick.

Equal care must be taken, whatever the filler, and when cement filler is used the traffic should be kept off the spot repaired for at least 24 hours, and 48 hours or longer is much better.

Such repairs should be inspected at frequent intervals until it is certain that they are again integral parts of the pavement, equal to the areas surrounding them.

That such repairs are possible, even by those not particularly expert, in such manner that they are scarcely recognizable as repairs, is shown by the photograph accompanying of two rows of brick replaced across the street, where they had been removed to insert a street-light wire.

Displacement of Sand Cushion.

Should the adjustment or the compacting of the sand cushion be improperly done, or should it be possible for water to displace it, there will be irregular settlements of the brick surfaces. When cement filler is used these settlements result in cracked and pinched joints and spalled bricks, either at once or later, and with any filler the irregularities in the surface of the pavement produce excessive wear and increasing roughness of the pavement.

Here again the repair of a light-traffic street can be delayed, but that of a heavy-traffic street should be made as soon as the defect is noticed and the weather permits.

The proper maintenance of a street requires that defects in the original construction should be corrected when the repairs are made which they have made necessary. The cause for the defect should be ascertained, if possible, and enough of the pavement should be taken up and relaid to bring up the quality of the disturbed section to that of the street in general. It is not economical to carry this relaying any farther than this or to make the relaid section materially better than the rest of the pavement.

Relaying Defective Surface.

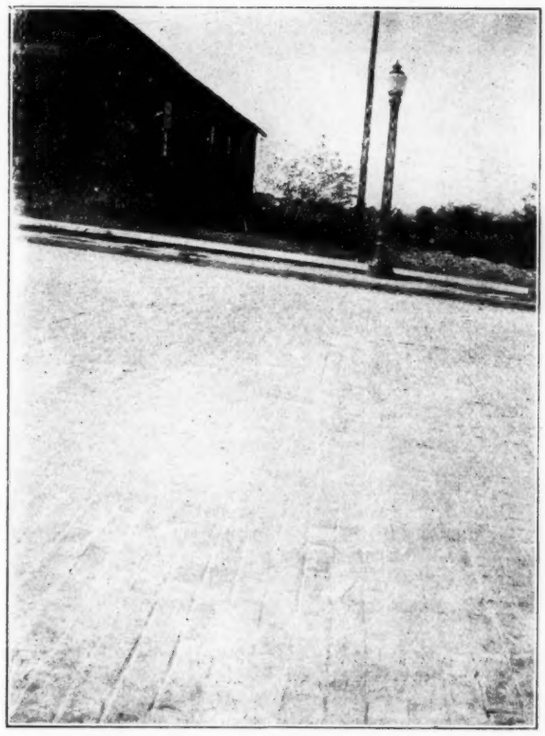
One of the accompanying photographs shows dimly the success possible in relaying a defective section of pavement so that the surface of the street is restored and the location of the relaid section is difficult to recognize. In this particular case some cement-filled street surface disturbed for excavations had been replaced by an area relaid with bituminous filler. This combination of two kinds of filler in the same area was causing the deterioration of the whole pavement, and so the whole affected area was taken out and relaid with cement filler.

The bricks were taken up and cleaned, the edges of the area being toothed so that the patch would join closely with the undisturbed pavement. Whatever old bricks could be used were used where they would fit best, quite a number of new bricks being required. The sand cushion was gone over carefully, and new clean material supplied as necessary. It was then carefully smoothed off to the required surface and compacted to some extent. The bricks were then laid in place. Lines of brick were laid across the open area where they would serve as guides and closing lines, and the courses of brick between these guide lines were carefully laid so as to close up as nearly as possible with only the widths of joint required by the lugs on the bricks. Very little trimming of bricks was required to make a neat and close-fitting job. The bricks were then thoroly tamped into place and adjusted until they formed a smooth surface, uniform with the surrounding undisturbed pavement. The grout filler was then carefully applied until all joints were thoroly filled, and traffic was kept off the area for 48 hours. The result is a patch, the edge of which must be hunted for, and a complete return to the original monolithic condition of the surface before the first excavation was made in the street.

These repairs were made by E. H. Christ, consulting engineer, in Grand Rapids, Mich., to whom we are indebted for the data for this description. Mr. Christ states that some of the patches made under the same contract as the above were protected from traffic for 24 hours and some for 48 hours, and he can see no difference in the results.

Cracks.

The subject of cracks in brick pavements is one on which there are so many differences of opinion that this article can only state a few of the problems and give such information concerning them as may be at hand, at the same time requesting contributions to the data available and criticisms of the opinions and results here offered. The discussion of cracks and their causes is applicable to any pavement, but the details concerning repair of them are here made applicable only to brick pavements.



TWO ROWS OF BRICK REPLACED OVER ELECTRIC LIGHT WIRE TO STREET LAMP.

Longitudinal cracks are attributed mainly to three causes: Insufficient allowance for transverse expansion, causing an elevation of the crown of the pavement sufficient to open a crack along the crown or at the weakest line of joints in its vicinity; heaving of the pavement, ordinarily attributed to absorption of water by the subgrade, freezing of water reaching subgrade or cushion producing an exaggeration of the heaving; settlement of a portion of the base, most likely along the edge, especially on a country highway.

Expansion and Contraction.

Many pavements, particularly on country roads where steel-tire traffic is not very extensive, go for many years with such cracks without serious deterioration of the pavement. Others are repaired by filling the cracks with a bituminous filler, which aids in keeping the surface water-proof and to some extent in protecting the edges of the crack from disintegration. Cement grout filling does not seem to be uniformly successful, as the next considerable increase in temperature produces the same rise in the crown and again opens the cracks. If the cracks are due to heaving or settlement, the grout filler may be more successful.

A complete cure for the longitudinal cracks due to temperature change would require the cure of the cause, which is probably either insufficient allowance for expansion or improper construction, causing obstructions in the expansion joint to the proper expansion of the brick or concrete surface. Flow of grout filler into the expansion joint, or leaving sand, bits of brick or concrete or other debris in the joint space cause longitudinal cracks in the pavement, and they are so

LARGE IRREGULAR PATCH IN GROUT FILLED BRICK PAVEMENT. SURFACE PRACTICALLY RESTORED TO ORIGINAL SMOOTHNESS AND CONTINUITY.

concealed that their effect cannot be exactly shown. It is seldom that the expensive reconstruction of the expansion joints along the curb is considered justifiable, and the filling of the cracks from time to time with a compressible filler is accepted as the best method available. In a heavy-traffic city street the life of the pavement is cut down, but the ultimate expense, including the earlier resurfacing required, probably justifies the course adopted.

If the cracks are due to heaving, drainage of the pavement is the only permanent cure, and this may mean a complete reconstruction, so the decision to fill the cracks with a grout or soft filler probably produces the most economical result.

In both cases the extra expense of keeping up the pavement and of the shortening of its life should be charged to defective design or construction.

With bituminous fillers no such difficulties arise.

Expansion Joints.

Expansion joints at intervals across the pavement were long considered necessary unless bituminous fillers were used, but the later years of experience have shown that so long as the pavement runs without material break in its surface, it is capable of carrying the strains from expansion by heat without injury, the only requirement being that there shall be no opportunity for movement. When a street surface has a straight line, or very nearly so, for surface cross-section, the longitudinal expansion joints along the curb are not necessary.

When an intersecting street is reached, if its crown is carried thru the intersection, it makes a break in the continuity of the pavement of the main street, and there is a probability of an arching of this cross-street crown and even an explosion of the intersection. On account of these frequent intersections of city streets, construction without cross-expansion joints is more satisfactory in country roads than in city streets.

Either the arching of the intersection described or the compression of a cross-expansion joint, if one is used at the intersection, allows a movement of the brick pavement in the vicinity. When contraction follows, the strength of the adhesion of joint filler with brick is not sufficient to draw the pavement back and there is a tendency to hair cracks in the joints, which later increase until the grout filler near the surface becomes disintegrated and the tops of the joints are left open and the edges of the bricks unprotected. This condition spreads until considerable areas of the pavement are affected. When these areas shall be repaired and how, is a question which no two street superintendents will answer alike, tho most of them will practically answer by letting the pavement go until the depreciation has become so great that holes are actually forming. This neglect greatly reduces the life of the pavement, but no one as yet has data enough to say what is the economical method of procedure.

One of the accompanying photographs shows a method of preventing the movement of the pavement at its end by putting in a heavy sandstone header, backed up so as to give weight and bearing enough to withstand the expansive force of the pavement. It will be noted that some tendency is shown to crowd the bricks up along the header at the ends of the short rows made because the railroad track runs diagonally across the street. This looks as tho the pavement were being shoved uphill (to the left), but is probably due to the lifting of the ends of these short rows on account of the transverse expansion. This displacement has not as yet become sufficient to warrant relaying, altho the pavement was laid in 1910. When the joints have been pinched and opened again often enough to show serious disintegration, the relaying should be done and the tendency of the bricks to rise near the header be restricted, if possible.

Iron Covers as Anchors.

The fourth photograph illustrates two or three difficulties met with in connecting brick pavements and iron covers.

At the right side is a defect which is found also in pavements where part of the pavement rises for any reason and has a tendency to fold back over the immovable pavement behind. The joints are pinched at the top and the edges and tops of the bricks are spalled by the concentration of the force on the upper edges of the joints, and the surface is left rough and jagged and ready for the destructive action of the traffic

HEAVY STONE HEADER AND BACKING AT DIAGONAL END OF BRICK PAVEMENT ALONG RAILROAD TRACK, NECESSARY TO PREVENT MOVEMENT FROM EXPANSION.

passing over it. Unquestionably such places as this should be taken out and replaced as promptly as possible. Whatever is the cause of the lifting of the pavement to produce the difficulty should be discovered and removed, if possible, and then the repaired pavement will keep its place. This may be the shoving of the brick against an immovable manhole top, as in the photograph, or the pushing of the casting into the pavement, or the partial sliding of a section of the pavement up on a header or an inlet or some other anchor which is not quite square with the pavement. Loosening up the anchor so that it can move with the pavement, if it is surrounded on all sides by the pavement, will prevent the same occurrence in the repaired pavement. Dressing the header so that the force will act at right angles to the bearing of the brick on the face of the header will hold the pavement in place. Each place has its own particular variation of the problem of keeping the pavement from moving.

The longitudinal crack running to the right from the manhole has been observed many times in well-designed and constructed brick pavements with manhole or other covers set solid on their bases so that they cannot move. They have been seen with both sand and mortar cushions under the bricks. They are likely to run in but one direction, but sometimes a smaller crack runs out in the opposite direction from the larger one. Again, when the pavement is weak, as it is near an intersection laid with diagonal courses, the cracks may run out in other directions and sometimes for considerable distances, following joints rather than breaking bricks, when the line of force is diagonal to the direction of the courses.

The crack is apparently caused by a lifting of the brick, but why the brick should lift at this particular spot (which may or may not be on the crown of the street), and not elsewhere in sufficient amount to cause or continue the crack, is not so evident.

The photograph was taken on a street in Greenville, Mich., laid in 1910, by E. H. Christ, of Grand Rapids, consulting engineer, which has shown but one such defect prior to the excessive hot weather of 1916, and now shows two or three. The pavement was laid under the specifications adopted by the A. S. P. S. in 1911 and had the closest of inspection under Mr. Christ and Charles H. Gibson, mayor of Greenville at the time, who were able in this way to obtain an exceptionally good street with remarkably few defects, the worst of which is shown in this photograph. Mr. Christ contends that if the manhole cover had been set free of the manhole and the concrete foundation so that it could move on the top of the concrete foundation of the brick pavement, back and forth as the expansion and contraction of the pavement might affect it, there would be no rock against which the wave in the pavement could break and therefore no defect in the pavement. He goes so far as to set lamphole covers over valve boxes, large enough so that the motion likely to occur in any direction will not be great enough to prevent the operation of the valves.

Most of the defects observed in brick pavements will arrange themselves in one or another of the classes above described.

Resurfacing.

Resurfacing is one method of maintaining a brick pavement, and is something to which every pavement is subject at some time.

The resurfacing may be done by taking up the brick surface, repairing breaks in the foundation, cleaning it up and laying a new brick surface according to standard methods. Before taking up the old pavement its defects should be studied carefully by an expert and the new construction should be designed to overcome the difficulties shown by the former pavement, the reason for which is usually not difficult to find.

DEFECT IN BRICK PAVEMENT DUE TO MANHOLE SET SOLID IN CONCRETE FOUNDATION AND INTERFERING WITH EXPANSION OF PAVEMENT.

When the brick pavement is rough and uneven, largely on account of rough and uneven tho thoroly compacted foundations, it may be advisable to resurface with some other material laid on top of the brick. This can be done readily if the brick surface has been worn down so that the thickness of the new surface material will not interfere with the proper drainage of the street. The only place where adjustment of the new and old surfaces is difficult is ordinarily in the gutters, where the old surface has not been worn down as much as the main traveled parts of the street, and along street-car rails. The latter adjustment is so difficult that it is seldom attempted.

Resurfacing with Asphalt.

Columbus, O., has resurfaced many old brick streets with asphalt, and the following description of methods and results is taken from a paper before the American Society of Municipal Improvements by Thomas H. Brannan, superintendent of asphalt:

One of the first questions to be considered in resurfacing brick with asphalt is that of surface drainage. All of our old streets were laid with a 6-inch gutter. After a 3-inch coat of binder and top has been put over the old brick, it therefore leaves a very shallow gutter. On streets having a lateral grade of 0.6 per cent. or over this is not so serious, but for grades less than 0.6 per cent. a 3-inch gutter may not be deep enough to carry the water. On these streets one of two things can be done, viz.:

The first method is to take up the old brick in the gutters for a width of 3 to 4 feet from the curb and lay a concrete base to such a grade that when the gutter is paved with new brick these brick will be high enough at the outer edge to form a shoulder for the edge of the asphalt and be 6 inches below the curb at the gutter line.

The second method is to take up the old brick for a distance of 3 to 4 feet from the curb, then concrete this space, leaving it low enough along the curb to lay asphalt and still maintain a desired depth of gutter. The outer edge of the concrete can be brought to the level of the old brick and an asphalt roadway can then be laid from curb to curb. This will increase the transverse grade or crown of the street near the curb, but not enough to be seriously objectionable.

Before any asphalt is laid on old brick it is essential that the old brick pavement be cleaned and all of the dirt removed

RESURFACING OLD BRICK PAVEMENT WITH ASPHALT USING BINDER COAT AND WEARING SURFACE COAT. ASPHALT LAID FROM CURB TO CURB.

from the joints to a depth of at least ½ inch. This is done most effectively by flushing with a fire hose. It can also be done by raking out the joints with sharp pointed picks, or hooks, and then sweeping. If flushed, it is necessary to give the street some time to dry out, and for this reason the sweeping is preferable during the late fall months.

In case the old brick are worn thru at any point or are more than 3 inches below the general grade, these holes or depressions are cleaned out and concreted. At intersecting streets it is necessary either to go back of the properly line a few feet and relay the brick, bringing them up enough to form a shoulder for the asphalt at the lot line, or to take up the brick in the wing and let the new asphalt pavement down enough to meet the existing pavement on the cross-street.

A closed binder, containing from 20 to 25 per cent. of material passing a 10-mesh sieve, is preferable to a paint coat. A paint coat of asphalt must be cut back with naphtha in order to apply it, and unless this naphtha entirely evaporates before the top is laid it is likely to work up thru the top and be detrimental to the pavement. The large variation in the thickness of the top, however, would be the greatest objection to the paint coat. The wide-tread roller bearing on the different depths of top, will compress the thinnest portion the most and leave the deep spots only partially compressed. Trucks going over the pavement after it is completed will further compress the deep spots and form depressions in the pavement. The depressions thus formed will likely produce shoving and destroy the pavement.

We use 1½-inch top and 1½-inch binder on these streets. The 1½-inch binder is figured on the basis of 1 cu. yd., box measurement, laying 20 sq. yds. Whatever excess there is over this amount is paid for by the cu. yd. as extra binder.

Where the brick foundation is very irregular the binder is laid in two courses. The depressions are first filled and rolled and then the 1½-inch binder is laid. An examination of the under side of a slab of binder taken from a cut on a resurface job of this character showed the print of all the brick, and also showed the binder driven in between the brick sufficiently to give a good bond.

The average amount of binder required on all the streets that have been laid was .022 of a cu. yd. per sq. yd. of top. This, at $7 a cu. yd., would be an item of about 15 cents a sq. yd. for extra binder. This amount, plus 5 cents a sq. yd. for cleaning, deducted from the cost of excavation and new concrete, represents the saving that can be made on this kind of construction.

In our city, with concrete figured at 70 cents a sq. yd. and excavation at 95 cents a cu. yd., this saving would amount to

Brick Streets Resurfaced with Asphalt—Columbus, Ohio.

Streets	Width	Completed	Thickness	Sq. Yds. Asphalt	Price per Sq. Yd.	Extra Binder per Sq. Yd. Top Cu. Yds.	Cost of Extra Binder per Sq. Yd. Top	Total Cost per Sq. Yd. Incl. Extra Binder
Gay St., High St. to 5th St.	46.5	11-1912	2 in.—1 in.	7,218	$0.92	$0.043	$0.05	$0.97
Fifth St., Long to Broad St.	24	11-1912	1½ in.—1½ in.	2,577	1.22	.005	.03	1.25
Sixth St., Broad to Town St.	30	11-1912	1½ in.—1½ in.	3,979	1.25	.0127	.09	1.34
Wilson Ave., Broad to Bryden	30	7-1914	1½ in.—1½ in.	5,037	1.37	.0313	.22	1.59
Monroe Ave., Broad to Oak	30	9-1913	1½ in.—1½ in.	1,274	1.40	.0301	.21	1.61
Grant Ave., Broad to Naghten	32	9-1915	1½ in.—1½ in.	4,793	1.36	.0261	.18	1.54
18th St., Long to Mt. Vernon	30	8-1915	1½ in.—1½ in.	3,264	1.35	.0207	.13	1.48
20th St., Broad to P. C. C. & St. L.	30	8-1915	1½ in.—1½ in.	10,716	1.36	.0366	.25	1.61
Bryden Rd., Ohio to Miller	40	7-1915	1½ in.—1½ in.	10,066	1.36	.0201	.13	1.49
10th Ave., High to Neil	30	8-1915	1½ in.—1½ in.	7,289	1.34	.0118	.08	1.42
15th Ave., High to Indianola	30	8-1915	1½ in.—1½ in.	3,943	1.36	.0154	.11	1.47
Dennison Ave., Buttles to Fifth	30	1916	1½ in.—1½ in.	13,720	1.39	.0371	.26	1.65
				73,876				

75 cents a sq. yd. of finished pavement. This saving, compounded annually at 4 per cent., would amount to $1.35 a sq. yd. at the end of fifteen years, or enough to almost renew the pavement.

Another advantage of this form of construction lies in the fact that it is not necessary to have a street torn up nearly so long for repair, and, if required, it need not be closed to traffic at all except on the day that asphalt is being laid on a certain portion of the street.

As a general proposition I would not advise attempting to surface over the old brick on a street having a car track. The only way that this can be done, if the brick are left in, is to raise the track, and this causes a bad condition with regard to the grade of the tracks at all intersecting car lines.

Bituminous Resurfacing.

The laying of a less expensive and apparently less durable resurfacing on a brick street is described by Herbert W. Hatton, consulting engineer, Wilmington, Del., in a letter to the editor, from which the following is taken:

In 1911 the writer was supervising the laying of 16,000 sq. yds. of brick pavements at Cambridge, Md. Part of this work was thru the business section and part thru the residence section. It was desirable to lay the one as durable as possible, while the object of the second section was to obtain durability, but at the same time to reduce the noise of such pavement to a minimum. To accomplish this result cement grout was used to tie the brick together in the business section and Pioneer Asphalt filler was used on the work in the residence section.

Strict supervision was maintained on all the work to see that the joints were filled from the bottom up and not poured cold just in the top of the joint. The asphalt was maintained so hot that it ran like water, and because of a 6-inch crown used in a 30-foot street, the asphalt ran from the joints on the side, flooding the brick. As the appearance was bad, instructions were given to use coarse sand in the top of the joint as soon as it was filled, and also to use the sand as dams to prevent the asphalt running out of the joint.

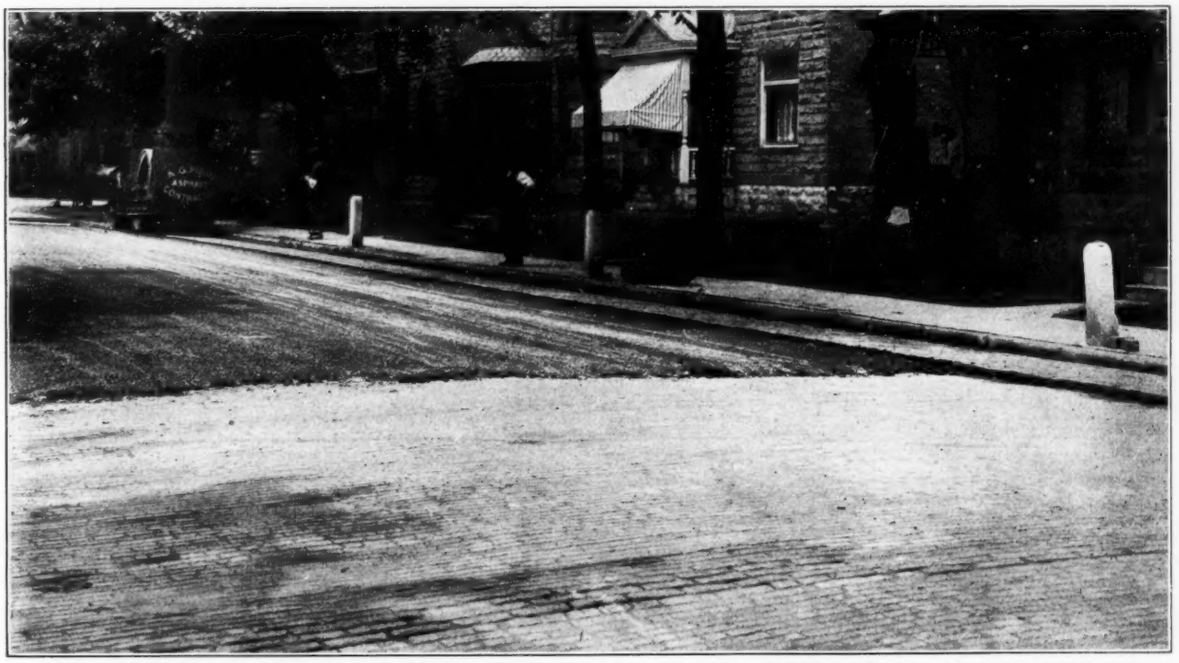
The result was that this entire section of pavement was covered with an asphalt coat and sand. Thus accidentally this pliable top was given to the pavement, which effectually deadened the noise, and at the same time gave two years of actual wear before the brick were exposed to traffic.

The city of Wilmington, Del., for many years laid brick and vitrified block pavements, and, using poor judgment, failed to place any but coarse sand foundations. In the early spring and during continuous rainy seasons the water would go thru the sand joints used and cause a floating or saturated sand foundation, with the result that the blocks became uneven and the edges badly spalled. Other vitrified block pavements which had been in service a number of years, laid on a concrete foundation, were also in need of repairs, so that, following the results obtained at Cambridge, the suggestion was made to use a tar or asphalt water-proofing cover on these brick pavements, and follow by using ¼ to ½-inch screenings, with dust out, to be ironed into the tar under traffic. Accordingly the street department undertook the work by force account to try it out thoroly, believing better results would be obtained when the work was not done for the greatest profit to be obtained therefrom.

The street was thoroly washed under a pressure sprinkling wagon and roped off from travel. All depressions of an inch or more depth were carefully cleaned when the street had dried and the sand or grouted joints were hand-broom swept after being scraped, and the dust and dirt removed. A day was selected when the pavement was thoroly dry; ¾ to 1-inch stone was placed in all depressions after the bottom surface had been tar-swabbed, using tarvia. The entire surface was then flooded with a ⅛-inch coat of tarvia A, being swept from joint to joint and carefully brushed and rubbed in with wire brooms. Immediately following the rubbing-in process ½ inch of dustless screenings was spread over the street to completely cover the tarvia, with the result that under traffic a street presenting a surface similar to bitulithic was obtained.

This surface still adheres after more than two years, showing that brick pavements can be repaired at little expense for many years of additional service when they appear worn out.

Ninth street, in the same city, was almost impassable, the brick being worn into deep depressions. It was decided to make more permanent work in making repairs. Accordingly the street foundation was carefully prepared in the same manner, but the stone pockets were omitted. Before placing the



RESURFACING OLD BRICK PAVEMENT WITH ASPHALT, USING BINDER COAT AND WEARING SURFACE COAT. NEW BRICK GUTTERS AND ASPHALT LAID BETWEEN THEM.

ABOVE: AN OLD BRICK PAVEMENT IN ST. JOSEPH, MO.

BELOW: THE SAME PAVEMENT RESURFACED WITH LUTZ SURFACE HEATER IN 1908 USING A TWO-INCH ASPHALT COVERING, AS IT APPEARED IN 1916 AFTER EIGHT YEARS OF WEAR.

tar coat, wrought iron nails 3 inches long were driven down between the brick joints about every four rows, a foot to two feet apart, staggered. The tar coat was then applied, and immediately thereafter a covering of bitulithic to a depth of 3 inches was placed. This was carefully rolled and a seal coat was applied. After five years of heavy traffic this street surface has remained in as good condition as when it was first placed.

A factor of vital importance in the selection of a type of pavement is the per cent. of grade and the crown given the street.

The secret of the durability of the pavement on Ninth street is its grade, which varies between 3 and 7 feet to the 100.

After making an extensive tour inspecting street pavements, thru the New England States south to Washington, D. C., careful observation permits the statement that all stone-mixed bituminous pavements must have a grade not less than 2 feet to the 100 to wear well, and if the fall is greater the life of the pavement is not hurt thereby.

In Waterbury, Conn., a bitulithic pavement on a .5 per cent. grade went to pieces in a year. In Wilmington, on Delaware avenue, where the grade is .5 to 1 per cent., the same results obtain, except that the life is probably one to two years.

Asphalts will not adhere as well nor the results of coal tar coats for resurfacing, and all pavement covers are inclined to peel and loosen unless the work has been done when the surface has been dry, with little or no moisture in the foundation. Any sweating of the foundation is sure to cause the surfacing to loosen and it provides a means for frost to get in its deadly work.

It is not possible to obtain good results unless the tar first coat is scrubbed in, as it were, with wire or very stiff brooms. This scrubbing cuts any dirt or dust coating held on the surface and gives the tar a chance to grab hold.

Standard Method of Making Repairs.

The city of Buffalo, N. Y., has the reputation of looking after its street repairs with the most minute care of any city, and its annual reports give in detail the cost of repairs in actual amounts spent, in cents per square yard actually covered by repairs, in cents per square yard of total area of each street repaired. With knowledge of the method of construction of each street, taken from the city's records, any desired study of methods and results can be made. For the purposes of this article the following statement of the methods of repair followed is sufficient. We are indebted to George H. Norton, city engineer, and J. A. Vandewater, assistant engineer, for it:

An inspection of all pavements is made each spring, as soon as the weather permits, and defects are noted. A list of the pavements in need of repair is then made and the streets are taken up in their order as nearly as possible, those in bad condition being repaired first.

Depressions exceeding ½ inch in depth under a 4-foot straight-edge, holes, disintegrated brick and cracks over ½ inch in width are taken up and repaired. The joints of the patch in the good pavement are carefully chiseled out, the old brick that are not broken or badly worn are thoroly cleaned and turned over when relaid. The brick are laid to fit the old courses and the joints properly broken. The sand cushion is raked up and enough new sand added to bring the brick up to about ¼ of an inch higher than adjoining pavement after ramming. This is done to allow for compression of the sand cushion. Joints are grouted in the usual manner with a mixture of one part each of portland cement and clean, sharp sand.

We have a few old pavements laid with a pitch filler, but we usually grout the joints. After repairs are made the patches are covered with a layer of sand to protect them from traffic, and they are also barricaded for about 48 hours, and longer if possible. Repairs are made with uniformity as to color of brick.

Where it has been impossible to obtain the same size brick as originally laid, a strip is taken up for full width of the pavement, relaid with new brick and the old brick used for patching. This frequently happens on some of the old streets which were laid with a small block.

Cracks under ½ inch in width are cleaned out and filled with a cement or bituminous filler.

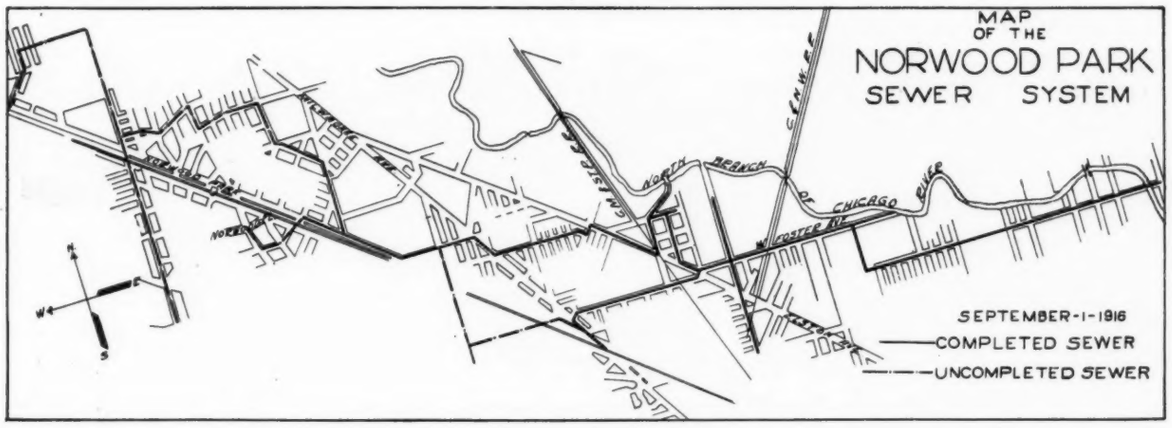
The repair gang consists of 3 pavers, 2 pounders and 10 to 12 laborers, and 1 or 2 teams, as required. Pavers are paid at the rate of 60 cents per hour, pounders 31.25 cents, laborers 25 cents and teams 75 cents. One of the pavers acts as foreman and locates the patches and size of same, keeps a record of the material used and the time of the men and teams.

The cost of repairs per square yard during the past five years was as follows:

1910-11	77.10c
1911-12	90.50c
1912-13	83.80c
1913-14	69.50c
1914-15	99.10c

This is the actual cost of work done on the street and does not include yard and office expense and supervision.

The cost of repairs on yardage maintained by city on streets repaired only during the past nine years varied from $0.0151 to $0.0716 per sq. yd. each year.



CHICAGO'S NORWOOD PARK SEWER

METHODS OF CONSTRUCTION

This brief article on a large subject touches points of value to the contractor and constructing engineer. The data are collected from various sources, including visits to the work in progress. The two contracts and the contracts for pipe-sewer branches to the main sewers are notable for the great variety of machinery in use on them, in sewer excavation, sewer laying, trench filling, etc. Not all of them could be covered in this article, but there will be others.

THE Norwood Park sewer system, in the northwestern part of Chicago, Ill., is a large one draining territory southwest of the north branch of the Chicago River and north of Wilson avenue to the western city limits at Maynard street, south of Bryn Mawr avenue, and the west boundary of Norwood Park and Edison Park north of that street. The accompanying map shows the extent of the two systems, the full black lines showing the brick sewers completed between July, 1915, and September 1, 1916, and the broken lines the sewers still to construct, which the contractor expects to complete in 1916, about a year ahead of the time set in his contract.

The system includes 14 miles of circular brick sewer, 2½ to 10 feet in diameter and 16 to 22 feet deep, and many miles of smaller vitrified pipe sewer.

Brick Sewer Contracts.

The brick sewer was let in two sections, No. 1, the Argyle street system, and No. 2, the Forest Glen system, both contracts being taken by the H. J. McNichols Company, of Chicago. The total amount of the two sections is about $750,000.

In each section the sewer increases in size up to 9 feet in diameter and has an overflow outlet into the North branch, the dry weather flow of sewage running farther down in a smaller sized sewer to a discharge into the intercepting sewer system of the city whence it is carried or lifted into the Chicago river on its way to the great drainage canal. Thus the sewer in West Foster avenue increases from 5 feet diameter at Milwaukee avenue to 9 feet near its overflow into the North Branch, but it divides there, the storm water excess flowing into the North Branch thru a 6.5-foot sewer and the sewage flowing in a 5-foot sewer to Argyle street and thence east, increasing to 6 feet at the lower end near North Francisco avenue.

The plans call for 3-ring brick work on all the sewer 6 or more feet in diameter and 2-ring on smaller sizes. Over 26,000,000 brick are used in the sewer. In Section 1 are included 121 manholes, 286 standard catch basins, 2 concrete bulkheads and a special brick overflow. In Section 2 are 184 manholes, 342 standard catch basins, 8 large catch basins, 1 bulkhead and a special brick overflow.

There are 4 street car crossings, 8 steam road crossings, 5 of which were tunneled and 3 timbered; one 24-inch and four 12-inch water-main crossings. Pavements on 15 streets and 7 intersections were taken up and will be replaced. Six old sewers were taken up and many connections were made with old sewers and drains.

The entire area is flat and much of it was low and swampy and will be greatly improved by the drainage afforded by the sewer. Most of the excavation has been in clay.

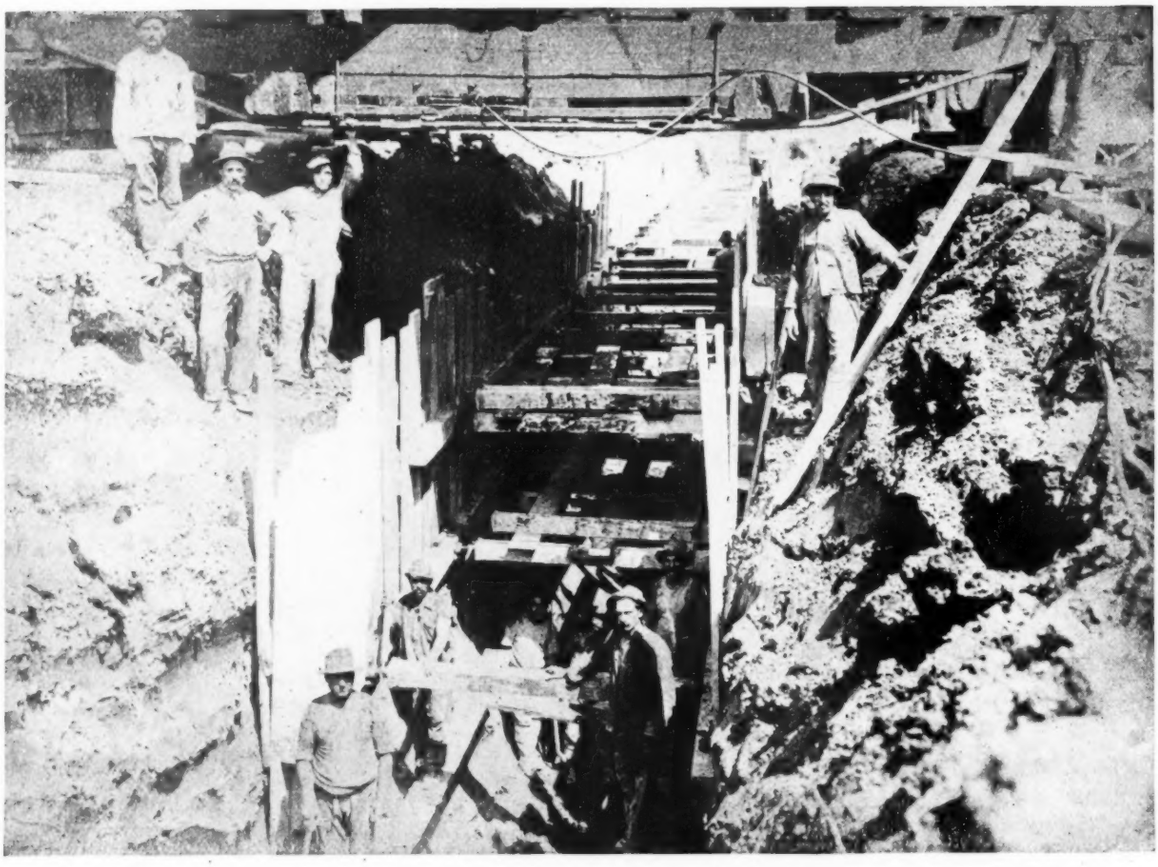
Trench Excavation.

The excavation of the trenches for the sewers over 4 feet in diameter, is done with steam shovels, Bucyrus 45-C shovel being used on Section 1 and a 60-C shovel on Section 2. The smaller shovel has a 30-foot boom, 40-foot dipper handle and 1-cu.yd. dipper, and the large one a 36-foot boom, 52-foot dipper handle and 1½-cu.yd. dipper.

The frames on which the shovels are mounted straddle the trench and are supported on wooden rollers, running on timbers laid along the trench. A cable attached to a convenient tree or to a deadman ahead is handled by an extra drum on the machine and hauls the machine ahead at each move.

The dipper of the 60-C machine has a heavy cutting lip instead of teeth and the bail is inside the lip so that it does not interfere with cutting the sides of the trench. The grade of the bottom of the sewer can be maintained within a fraction of an inch if the operator is expert, and it requires very little trimming to fit the bottom of the trench to the shape of the sewer brick work, whether it is circular, as in good material, or is flat or any other shape required for a foundation in poor material.

The shovel excavates from 12 to 16 linear feet of trench at each setting, the distance depending on the depth of the trench and the length of the boom. The sides of the trench require very little trimming to make them smooth enough to set the trench sheeting and bracing, and this is done as soon as the section of the trench is excavated and before the machine is moved forward. The wait is very short, and the machine is quickly moved forward to begin work on the next



SHEETING AND BRACING GANG AT WORK UNDER STEAM SHOVEL WHICH IS READY TO MOVE UP.

section. One large photograph shows the trench excavated, the sheeting and bracing placed and the machine ready to move forward. The frame, the rollers and the timbers on which they travel are clearly shown. One of the small photographs is a view on the surface, showing men laying planks for the rollers getting ready to move the machine forward.

The last photograph, looking back from the machine, shows the bricklaying.

There are 3 men required to operate the steam shovel, 2 men smooth off the bottom, 4 men do the sheeting and bracing, who are served by 4 men passing the sheeting down and 4 men pulling the sheeting in the completed section. This is the average force on a 9-foot sewer.

Brick work is kept up close to the rear end of the shovel, invert being laid first and followed by arch on wooden forms in the usual way. For 9-foot sewer, 10 brick layers are required, with 5 tenders.

These men constructed about 150 linear feet of completed 9-foot sewer in an 8-hour day. On 6-foot sewer the average is 200 feet a day.

On Section 1 there was considerable sewer 4 feet or less in diameter. On this work a steam Parsons trench excavator was used. It cuts a trench 78 inches wide and up to 20 feet in depth.

Trench Filling.

The process of filling the trench over the completed brick sewer included two stages. Immediately behind the brick laying and as soon as the cement mortar had set, earth was shoveled in and tamped in place along the haunches and over the arch so as to well cover the sewer. The black surface soil is more easily handled and if convenient was used first, followed by the clay of the lower part of the excavation.

Much of the sewer is located in areas as yet undeveloped and so the immediate consolidation of the earth in the trench is not everywhere insisted upon. At a convenient time the second stage of the trench filling is completed with a back-filling machine. After the steam shovel on Section 1 followed a steam tractor on the front of which was mounted a swinging boom which can be raised and lowered. This is operated by a hoisting engine, which also operates an ordinary drag scraper of about a half-yard capacity. On the tractor are an engineer and fireman. Two men handle the scraper, to guide it to fill under the pull from the engine. As observed by the writer, an average of 5 scoops a minute seems easy to maintain. The earth is hauled thus into the trench and is heaped up over the trench to a height of 2½ feet above the tops of the manholes, making the total depth of fill at that place 12½ feet, the width of trench at bottom being that for a 5-foot brick sewer, or about 6½ feet, since it was not necessary to carry the trench bracing below the springing line of the sewer arch. The boiler requires 1,000 to 1,100 pounds of coal per 9-hour day. The contract price for filling this trench was 35 cents a linear foot. The boom of the machine is 52 feet long and the scraper can be thrown by the engineer some 10 or 15 feet beyond its end. The tractor wheel rims are widened by the use of wooden slats and it runs along the open side of the sewer, and draws the earth from the bank on the opposite side, so that a considerable width must be covered by the boom and the scraper. The machine observed was put together by Sol McKeen and he holds patents on some of its details. He expects to make some improvements which will reduce the number of men required to handle the machine. When the machine is used to fill pipe sewer trenches, 24-inch tile or less, the machine will fill 1,600 feet of trench per 9-hour day.

Behind the Parsons excavator a smaller machine of like

LAYING PLANK TRACK FOR ROLLERS UNDER MACHINE IN PREPARATION FOR MOVING UP.

nature with gasoline engine is used. Surplus earth is used for filling low areas in the vicinity.

On some parts of the work the earth as excavated was dumped into cars and hauled back and dumped on the completed sewer behind.

On Section 2 the backfilling was done with a Marion revolving steam shovel equipped with an orange-peel bucket. This machine was moved forward on wooden platforms, which were picked up in the rear by the revolving boom and set in place in front by it. The crew of this machine consisted of the operator and 4 men. Excess material was used for leveling streets.

Many branch pipe sewers are being laid to connect with the completed portions of the brick sewer.

Backfilling Pipe Sewer Trenches.

For backfilling these pipe-sewer trenches, small backfillers are used. One of these observed is operated by the builders, A. Vogt and Son, and they have had it in use about four years. The frame on which the gasoline engine, hoisting machinery and boom are mounted is on wide-rim wheels of small diameter and the machine is moved forward as desired by means of a block and tackle attached to a pin driven in the ground ahead and pulled by a horse. The boom does not swing. The flat scraper is hauled back by a man and held in place to drag its load into the trench. The operator, a scraper man and a horse driver who is also a general utility man, are required to operate the machine. It will fill 400 to 600 feet of trench a day. The price for filling pipe sewer trench is 6 to 7 cents a linear foot, according to depth and conditions, heaping the earth up over the trench. If the trench must be flushed or otherwise consolidated, so that the machine must go over it a second time, the cost is increased.

Another trench filler in operation on pipe sewer connections was the P. & H. machine described in MUNICIPAL ENGINEERING in September. This machine, made by Pawling and Harnischfeger, of Milwaukee, Wis., is mounted on a caterpillar tractor and is moved forward and back at will by its own power. The design of bucket is such that it is drawn into the earth to be moved by the line to the hoisting engine, so that on straight work but one man is necessary to complete the filling. When the earth is to be heaped up over the sewer and not otherwise compacted, this machine will fill 900 feet of pipe sewer trench per 9-hour day. The machine is light and is easily handled and the caterpillar tractor makes it possible to run over irregular and loose soil and even bridge small trenches.

We are indebted to C. D. Hill, chief engineer for the Board of Local Improvements, for data, and to *The Excavating Engineer* for illustrations used in this article.

LOOKING BACK FROM THE STEAM SHOVEL OVER THE BRICK-LAYING GANG, SHOWING COMPLETED INVERT IN FOREGROUND, ARCH FORMS, BRACING AND SHEETING IN PLACE, BRICK LAYERS AT WORK AND FIRST STAGE OF TRENCH-FILLING PROCESS.

Paving by Direct Labor versus Contract Work

By Charles A. Mullen, Director of Paving Department of Milton Hersey Company, Montreal, Quebec.

The author, who is director of the paving department of the Milton Hersey Company, chemists, engineers and inspectors, prepared for A. Guy Ross, one of the five members of the board of control or city commissioners of Montreal, Que., the following parallel between street paving by the city on force account and by contract. There is a pronounced tendency in the comparison to put the statements on the day labor side of the page in the form most favorable to that system, and to put the statements on the contract side in the form most unfavorable thereto, which makes it necessary for the reader to weigh each comparison carefully and correct it according to his own knowledge and experience. Nevertheless, the points for consideration are clearly and concisely stated and the ground is very thoroly covered, so that the article can be used as a guide to a thoro study of all phases of the subject.

The points on the two sides are arranged in two columns opposite each other for convenience of comparison. The left hand column shows the case for the day-labor system and the right hand column the case against the contractor.

Mr. Mullen wrote this article in advocacy of day labor, and is quite willing to have some advocate of the contract system recast the facts as he sees them, which MUNICIPAL ENGINEERING *will also be very glad to publish.*

THE City can, if it will, employ the best men, purchase the best materials and equipment, and proceed with paving or other public work in the best possible way. No one can do better.

The City, having control of a definite and large amount of work, can employ men steadily, and guarantee them better working conditions.

The City, having control of the full purchasing power and a knowledge of the local supply, can secure the best unit prices and best deliveries.

The City, knowing that it will be in business this year, next year and the year after, can afford to purchase and install the most modern and efficient equipment, and to acquire sources of supply for materials where possible. A sand bank and stone quarry should be acquired in the case of nearly every City.

The City knows it can proceed with its paving industry in a definite and assured manner, with more work to do each year, and its equipment never idle or scrapped for lack of work ahead.

The City knows it can do the work as economically as any one. If labor gets more pay, the cost goes up correspondingly and no more. If labor is more efficient, it results in a benefit to the general public. The City gets what it pays for and pays for what it gets.

The City employes have no incentive to do poor work. They do not profit by putting less than the required amount of material into a mixture, or by laying less than the required thickness. If their work is not good, they are very likely to lose their jobs. The quality of the work is the primary factor, the cost is secondary.

The City Manager of public works will require, if he is a good man at his job, that the work be well done, without the waste of either labor or material, so that ultimate human economy will be attained.

The Contractor can, if he will, employ the same men, purchase the same materials and equipment, and proceed with paving or other public work in the same way, and no better.

The Contractor, depending upon the chance of each letting of contracts for his work, cannot guarantee men steady employment.

The Contractor, having control of but that part of the purchasing power embraced in his contract, cannot secure the best unit prices or the best deliveries.

The Contractor, not knowing that he will ever get another job at the same place, must be very circumspect in his investments in equipment, often using inferior machinery that represents a smaller investment and therefore a smaller possible loss. He cannot afford to acquire sources of supply especially for the purpose of a single paving contract.

The Contractor has no assurance of what tomorrow will bring. He takes a gambler's chance, and charges for it in the price of pavement. Gambler's chances do not wear well as street surfaces.

The Contractor knows he cannot do the work as economically as the City, but believes that by paying his labor less and working his men harder, he can overcome the difference. To this he must add his various expenses, and—last but not least—his profit.

The Contractor's employes have no incentive to do good work. Their employer profits by putting less than the required amount of material into a mixture, or by laying less than the required thickness. If their work is not cheap, they are very likely to lose their jobs. The cost of the work is the primary factor, the quality is secondary.

The Contractor Manager of public works will require, if he is a good man at his job, that the work be done at a profit —honestly if possible, but at a profit anyhow. He has no thought of ultimate human economy in the matter.

The City can do all its paving work under one centralized management. It occupies but one office. Employs but one estimator, one cashier and one overhead organization thruout, thereby effecting the greatest possible economy in those who are indirect and not direct producers.

The City employes do public work with a view to having it last as long as possible at a given unit cost that is based on a study of ultimate economy. They have not in mind the showing of a profit on their employer's books, and can work scientifically and unhampered.

The City can re-use all old material that is taken from the street in the process of preparing it for paving, or other old material that it may be securing at the same time from other sources, or that it may have on hand. This is an important item that will grow in importance as the years pass.

The City will do the best possible job under a given specification. It is to the City's interest to do so.—Note *a*.

The City can easily adapt its work to any change in conditions as time, material, supplies, the public demand, and more modern knowledge seem to dictate. It makes no iron-bound contract with itself. (*b*)

The City does not need to give itself a surety bond. It wants the work done, can do it, and proceeds at once with the actual construction. (*c*)

The City does not need to give itself a guarantee. It does the work itself, knows what it is and whether or not it will last. City-made pavements usually do last—without the guarantee. (*d*)

The City asphalt plants have never been known to bribe or attempt to bribe city inspectors, city engineers, city superintendents or the mayors of cities.

The City does not need to employ "stand up" inspectors on its own work. It only requires a force of men to control and direct its operations, and these men can proceed without outside interference from counter interests.

The City usually has in the bank, while the work is in progress, the money to pay for the work as it is completed. If this money is not being used by the City, the bank has it to loan to the contractor at a high rate of interest.

The City asphalt plants do not hire lawyers to bring suits against the City for "extras," breach of contract, and a number of other items well known to the legal profession.

The City, in doing its own work, will make many improvements in the equipment for and the process of manufacture, and the improvements will belong to the City.

The City lays street paving for use. All its employes' efforts are naturally bent in the direction of securing the greatest use value. (*e*)

The Contractor must have his own overhead management, and each other contractor competing with him must have the same. He must have his separate office, his separate estimator, his separate cashier and his separate complete staff of clerks, whether he always has business for them or not.

The Contractor does public work with a view to having it last—if he is a wise contractor—at least until he can get to the City Hall and collect the money. All contractors have not been wise, and some paving work the writer has in mind did not even last that long.

The Contractor cannot be trusted to use old materials judiciously, and if he could, it is above reasonably human possibility to draw a contract, in most cases, that would give reasonably definite limits for the re-use of old material and a just credit to the City therefor.

The Contractor will do the cheapest possible job under a given specification. It is to the Contractor's interest to do so.

The Contractor will stick to his contract, and if the City wants to make a change, the City will have to pay the Contractor liberally for the privilege of doing so, as he has acquired contract rights.

The Contractor must give the City a bond, which costs him in the neighborhood of one cent per square yard. This he adds to the price he quotes the City.

The Contractor gives the City a guarantee bond. The bonding company charges him about one cent a square yard for this, which the Contractor also adds to the price he quotes the City.

The Contractors have been notoriously guilty of bribery in all its forms, even reaching in some cases to the bribery of the governors of states.

The Contractor must employ the same men to control and direct his work that the city would require, and the City must then employ and pay additional men as "stand up" inspectors to see that the contractor's men do as directed.

The Contractor usually goes to the bank, borrows practically the City's money, pays interest on it, and then charges the City interest for the use of practically its own money, figured as an overhead cost, in the Contractor's unit price for paving.

The Contractor frequently works on the basis that there is more money in suing the City than in doing the work. He knows how to trump up all sorts of fictitious claims, and his lawyers frequently put them over.

The Contractor, in doing the City's work, will also make some improvements in the equipment for and the process of manufacture, and the improvements will not belong to the City.

The Contractor lays street pavement for profit. All his employes' efforts are naturally bent in the direction of extracting the greatest possible profit.

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a—The difference between the best job and the poorest job that can be done under the standard specifications for asphalt pavement is very considerable—yet, both will meet the requirements of the specifications and the contractor would be able to collect the same amount of money for the poorest as for the best. Specifications must be drawn with some latitude, or they are unworkable and will not hold at law.

b—The City of New York built a driveway for speeding horses about ten years after the public had taken to speeding automobiles. The contract had been let many years before, and while the preliminary work of regulating and grading was in progress, the public demand changed. This was a contract running into several millions of dollars.

c—Contractor's surety company bonds are notoriously not good, as the writer found out in detail at Schenectady, New

York, where a contractor, whose city specifications had called for concrete under curb, had "forgotten" it; and when this was found out, the City was not able to collect damages from him or his surety, or to make him deliver the goods for which one of his former associates in the City employ had paid him.

d—What the City wants is good pavements on its streets, not red tape and gilt-sealed guarantees on bonding company stationery. A good asphalt pavement should last ten years on a very heavy traffic street and one has now lasted thirty-seven years on a medium traffic street, Vermont avenue in Washington, D. C., laid in 1879, in front of the old Arlington Hotel. Why then should a City be satisfied with a pavement that is guaranteed by some Contractor and his bonding company to last five years, and laid by the Contractor of the cheapest quality that he thinks will last just five years and one day.

If the Contractor's pavement fails, before his five-year guarantee expires, the bonding company pays its lawyers liberal fees to prove it wasn't the Contractor's fault anyway—and the lawyers usually succeed.

e—The City that, having its own municipal asphalt plants, talks of abandoning them to go back to the contract system, if its officials are honest but misguided, merely seeks to exchange the evils that it knows for the far greater evils that it knows not of. The City government that is too incompetent to do work by direct employment will also be too incompetent to get any but the worst results from the contract system, plus all the disadvantages above enumerated.

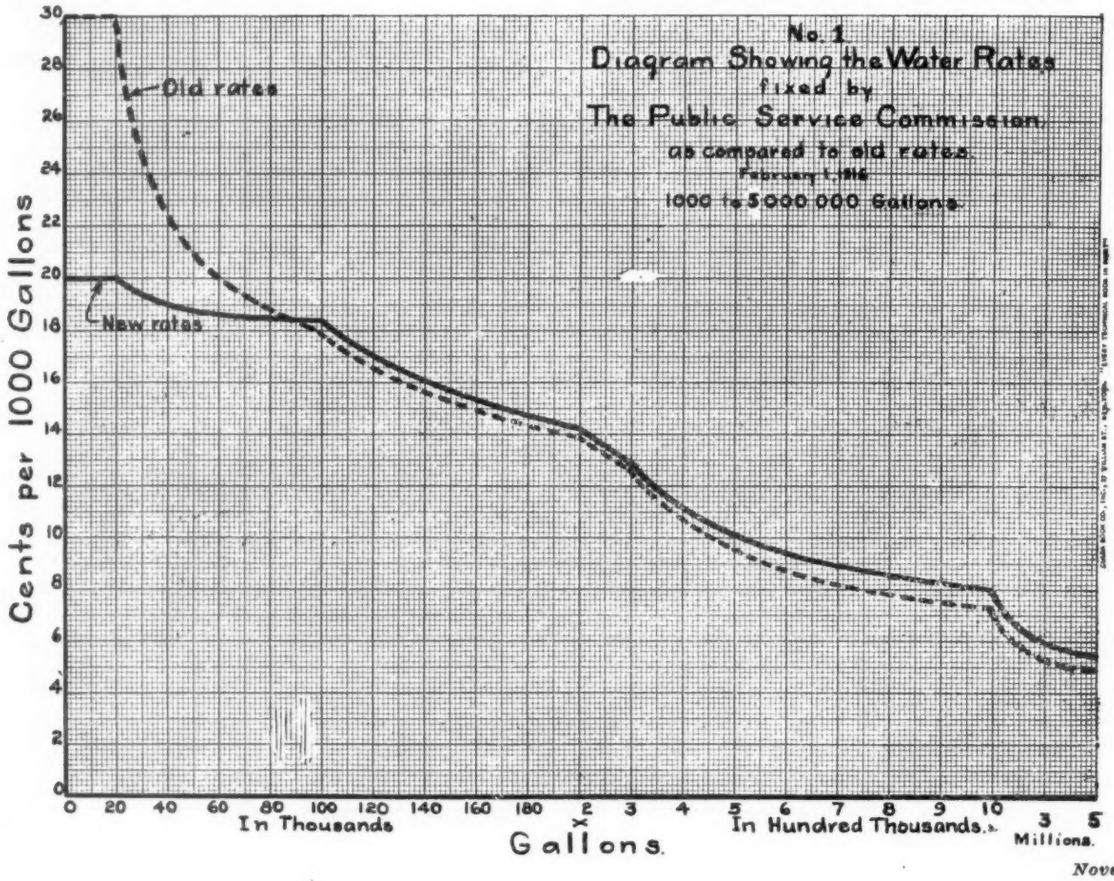
In conclusion, whenever a City government is in a position to take the entire output of an economical unit of any industry, the City should own such a unit of that industry and operate it by direct labor efficiently employed under specialists in the particular field, paying the best of wages, maintaining the best possible working condition, and requiring faithful and loyal public service from the men employed therein. A City will thereby create its own public monopoly, doing away with the duplication, and waste, and private profit for which no adequate service is rendered, that are the undeniable fruits of competition for the right to take an unearned profit from the City treasury.

Effect of Water Rate Changes

In February the Indiana Public Service Commission modified the rates for metered water of the Terre Haute Water Works Company, the following table showing the new rates and the old rates. The reductions are for the small consumers, and there are increases of most of the rates for the larger consumers:

	Per 1000 Gallons. New Rates.	Old Rates.
For the first 20,000 gallons in one month.	20c	30c
For the next 80,000 gallons after the first 20,000 gallons, in same month.....	18c	15c
For the next 200,000 gallons after the first 100,000 gallons, in same month...	10c	10c
For the next 700,000 gallons after the first 300,000 gallons, in same month...	6c	5c
For the next 2,000,000 gallons after the first 1,000,000 gallons, in same month..	5c	4½c
For the next 6,000,000 gallons after the first 3,000,000 gallons, in same month..	4½c	4½c
For all in excess of, or in addition to, the first 9,000,000 gallons, in same month	4½c	4¼c

The company has prepared a diagram showing the two schedules of rates, the old shown by the broken line and the new by the full black line. The sudden changes in the lines are caused by the change in the horizontal scale at the 1,000, 100,000 and 1,000,000-gallon points.



November, 1916

REMOVAL OF SNOW IN PARKS

PROBLEMS AND METHODS

By H. S. Richards, Superintendent of Maintenance and Repair, South Park Commissioners, Chicago, Ill.

Prompt removal of snow is found to be the most efficient and economical method in the parks of Chicago, as well as in the streets of New York. The system in the latter city was described in MUNICIPAL ENGINEERING *for February, 1916, vol. L, p. 220. In the following article the author describes the system in use in the South Park district of Chicago. It was presented to the American Society of Municipal Improvements at its last meeting.*

ONE of the most exacting duties of a park official is that of maintaining walks and drives in good condition for travel at all times, even during or shortly after the severe snowstorms of winter. In a park and boulevard system like that of the South Parks in Chicago, which has boulevards leading thru the crowded downtown business districts, where the traffic at certain hours is exceedingly dense, as well as thru the residence districts in which travel is rapidly increasing year by year, problems are met with that are sometimes quite difficult of solution. In this paper I will deal with those concerning snow removal and disposal as they are handled by the South Park Commissioners, Chicago.

The operations connected with this line of work may be outlined as follows:

1. The necessity for an immediate opening of paths thru the snow on the walks and drives and this for several reasons—

(a) to facilitate traffic;

(b) to prevent packing the snow which would result in an increased cost of removal;

(c) to protect the pavements from the wear occasioned by traffic, which usually follows the ruts worn in packed snow;

(d) to prevent the possible formation of a dangerous icy coating by alternate thawing and freezing.

2. The actual removal or disposal as soon as possible after paths have been opened, of all snow from walks and drives in the busy downtown sections by hauling to the dump or otherwise.

Horse-Drawn Plows.

As to the methods of handling the snow-cleaning problems, the first means used for cleaning the walks and opening paths on the drives was that of horse-drawn plows. On all the walks, except those in front of business houses in the downtown district, who clean the snow off their walks and deposit it in the streets, both one and two-horse plows are used—the V-shaped plow for one horse and small road graders for teams. These types have answered the purpose fairly well as they are easily handled.

Snow removal from the drives has proved a more difficult problem, as some traffic is constantly passing along packing the snow, even while it is falling. The type of horse-drawn plow that has given most satisfactory service has been the four-wheeled adjustable-blade road grader. Hitches of from two to four horses, depending on the depth of snowfall and its character, as to whether it was dry and light or wet and heavy, have been used on a machine. On most of the boulevards and in the larger parks these plows are used in groups of four to six, all traveling in the same direction and lined up diagonally in such a way as to clean the entire drive in one round trip. The first plow throws the snow from the center of the drive toward the gutter, each succeeding plow cleaning its swath and throwing the ridge of snow closer to the gutter until the last plow has piled it up along the curb. In going in one direction one-half of the driveway is cleaned and on the return trip the other half. Some of the boulevards have two drives, one on each side of a central strip of lawn. On these the snow is all cleaned towards the central parkway so as not to pile it up in front of the homes on either side of the boulevard.

In the South Park System there are at present 45 miles of drive from which snow is cleaned in winter. To cover these drives with horse-drawn plows in a reasonable time would require a larger equipment of horses and plows than now on hand—in fact, several times as large—as the horses cannot travel faster than a walk thru the snow and altho heavy draft horses have always been used, the work with a moderate snowfall is quite wearing on them. While horse-drawn plows are covering their routes some snow is being densely compacted by the constantly passing traffic, with the result that these plows remove little more than the loose snow, being practically unable to rip the packed snow off the pavements, to which it adheres very firmly. Ruts are formed in the packed snow and traffic following these ruts wears down thru the snow to the pavement. As automobile tires in winter are usually equipped with chains, the resulting wear of such traffic on the narrow strips of pavement at the bottoms of the ruts damages the pavement considerably, necessitating costly repairs in spring.

Motor Snow Plows.

As soon as motor trucks became practical vehicles we tried various snow plow attachments on them, but have never found one that will clean snow as desired. Quite a little time and money was spent in fitting up a five-ton truck for snow cleaning work, but it did not give satisfactory service. One of the chief difficulties for a long time was the lack of traction when moving ridges of snow from the centers to the sides of the drives, even after a moderate fall of snow. As soon as the ridges acquired any depth to speak of the motor plows became helpless thru lack of traction, not that the motors were not powerful enough, but because the trucks become "stalled" and slide sideways with the rear wheels revolving on the pavement.

In the winter of 1914-1915 a new type of snow-cleaning machine came to my notice. This outfit consisted of a three-wheeled gasoline tractor fitted in front with a V-shaped plow or mold-board which was removable, and a large revolving street broom mounted on wheels to be attached behind the tractor. The construction of the outfit was quite heavy so as to withstand the strain of plowing thru banks of heavy wet snow. The plow blade has considerable curve, which causes it to travel quite close to the pavement when plowing, and on one side of the plow there is an adjustable extension or wing, which can be set at any desired angle as conditions require.

Demonstrations were given which showed the ability of the outfit to operate satisfactorily under the different conditions of snowfall usually met with, and the result was that the Park Commissioners ordered three of the outfits for service in the winter of 1915-1916. As the need for snow cleaning is felt most in the congested downtown district, which is also the most difficult district to clean, the three tractor plows

TRACTOR HAULING LOADED WAGON.

were assigned principally to that district. After various preliminary trials it was learned that the broom attachments were the best for cleaning walks and for very light snow on the drives, while for the heavier snows the tractors gave better service with the plow attachments. It was finally decided that the best plan for this district was to fight the snow while it was falling and not permit it to accumulate at all nor give it any chance to become compacted by traffic.

So it was arranged that two of the tractors with brooms and the third with plow as well as revolving broom should be put into operation shortly after snowfall began and continue operating as long as snow was falling. The third tractor was equipped with a plow in addition to a broom because it had to move the ridge of snow swept aside by the two tractors immediately preceding it. The snow was cleaned from the center to the sides of the drive, the machines traveling with the traffic at a rate up to ten miles per hour, so that they made a round trip over a particularly busy stretch of downtown boulevard a little over a mile in length every fifteen or twenty minutes. The snow is continually being brushed towards the sides of the drive ready for hauling to the dump, so that practically as soon as the snowfall ceases the machines are thru with this stretch of downtown driveway and it is in good condition.

When the machines finish work on the above mentioned drive the revolving brooms are removed, the tractors hook on the plow attachments and are then sent out to assist the horse-drawn plows in cleaning the balance of the park and boulevard drives, the tractors being given the preference for the busy boulevards, as their rate of travel is much greater than that of the horse plows, making them less inconvenient to the traveling public. By changing shifts of drivers the tractors can be operated twenty-four hours per day; this makes them of special value for work during the night, when we do not have horse-drawn plows in operation and when the traffic is not so heavy as in the daytime. Altho the road graders could also be operated all day and all night with changes of horses and drivers, that plan is not so practical on account of our inability to secure additional teams and drivers after storms, which is the time we need them the most; and the additional cost would be considerable.

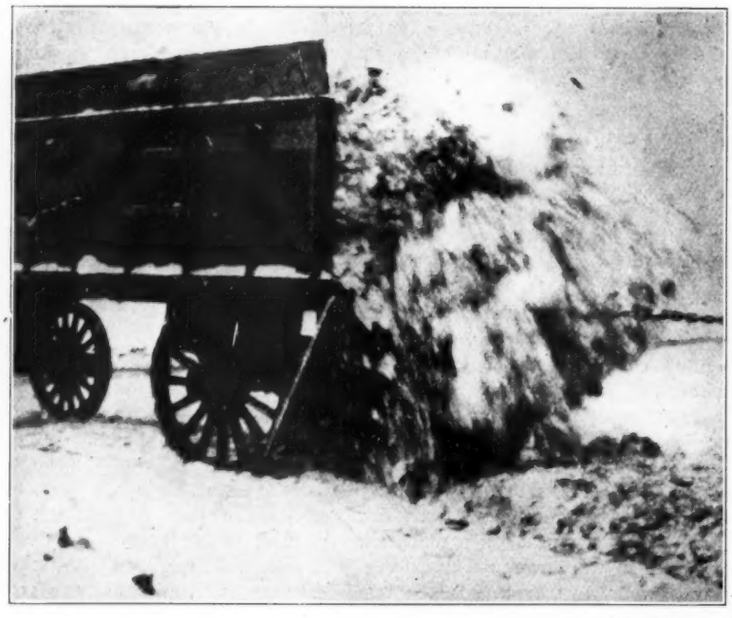
These outfits have been tried out on light dry snow, heavy wet snow, sleety or icy snow and snow packed by traffic, and under these different conditions they have given first-rate service. At their rate of speed of nine to ten miles per hour, with sweeper attachments, they are able to secure good results with revolving brooms in places where horse-drawn sweepers will not operate properly. The speed of the latter is not sufficient to revolve the brooms fast enough to prevent the bristles becoming clogged with snow, in which condition they will not sweep the snow aside. This trouble is not experienced with the tractor brooms, as they revolve too rapidly to become clogged, and consequently clean the walk or drive pretty thoroly. With our three tractor outfits we have been able to keep a section of down-town drive one and an eighth miles long practically clean and open for traffic during a snow falling at a rate not exceeding one inch per hour. It is our intention to add to our motor snow-cleaning equipment year by year so as to gradually replace the horse-drawn plows.

Cost of Snow Removal.

As to the comparative cost of work done by tractor plows and by horse-drawn plows, carefully kept records show that we have been able to do snow cleaning with tractors at a cost considerably less than that of work done by horse-drawn machines. The tractor outfits are particularly valuable in breaking up packed snow and ice, and in plowing on the drives they can throw the snow in ridges several feet deep on top of the curb, leaving the gutters entirely free and open, which is a most desirable feature. Horse-drawn machines are able to plow only a part of the snow up over the curb, leaving most of it in the gutters.

No matter how well a working force may be organized, it seems that at times, as in emergencies for instance, previously

DUMPING LOADED WAGON. 11,600 LBS. OR 14 CU. YDS. AT 830 LBS. PER CU. YD.



made plans will not work out to perfection. Sometimes we get caught by sleet storms, which cover the drives with frozen slush and ice, leaving them in a bad and dangerous condition. After one such storm last winter considerable slush was frozen on one section of driveway which we had been unable to finish cleaning before it froze. The next day the ice was picked loose and hauled to the dump. When using laborers it was found that it required four men with picks to loosen enough to keep a team busy hauling it away. We soon learned that a tractor pulling a road grader worked very well on the frozen slush and ice and with this combination enough was loosened in one hour to keep seven teams busy four hours.

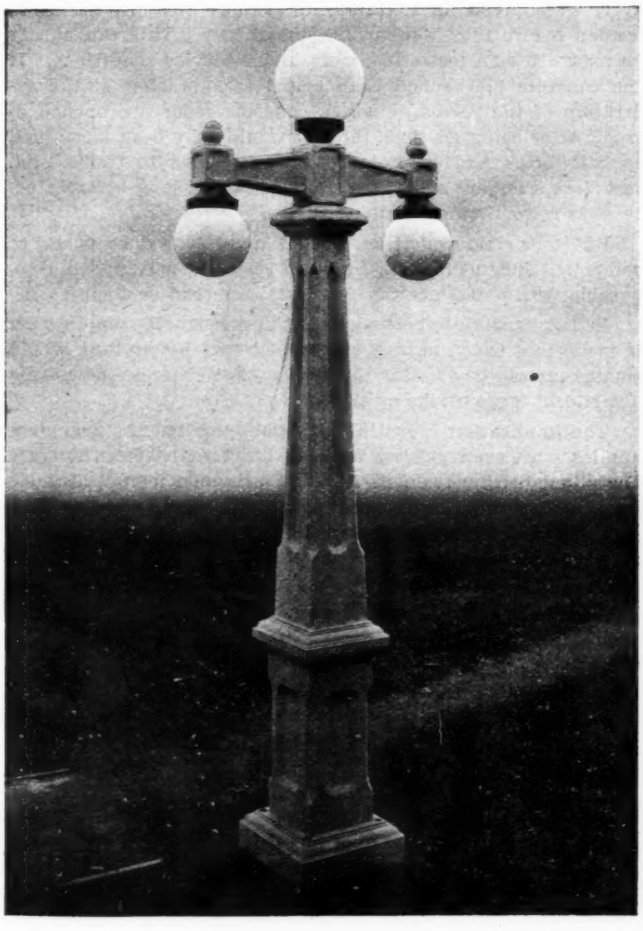
Disposal of Snow.

In addition to plowing or sweeping, the tractors, with plow and broom attachments removed, have been repeatedly used to good advantage in hauling wagons loaded with snow from the down-town district to the dump. For one of the tractors an especially large wagon, holding 14 cubic yards, water measure, was built, and the tractor had no trouble handling it. A special device fitted to this wagon enabled the tractor to dump out the 14 yards of snow in a few seconds.

I have for some time thought of disposing of the snow on the down-town boulevards thru the sewers, so as to eliminate the expense of taking it to the dump, so last winter a device consisting of a water turbine armed with three free blades and mounted in a wire cage or basket of a size to permit it to be set in a sewer manhole was made and tried out. The water turbine was connected with a fire hydrant, the stream of water revolving the turbine and then flowing thru the wire basket into the sewer. The free blades on the turbine agitated the snow shoveled into the basket and mixed it with the water, which carried it on thru the sewer. With a pressure of 15 to 25 pounds the machine disposed of all the snow that two men could shovel into the wire basket, and with a higher pressure it should take care of all that four men can shovel into it.

Granulated rock salt sprinkled over the drives has also been used for removing snow. There have been some complaints, however, against its use on the park and boulevard drives, the chief objections being that it has a tendency to melt the snow and form puddles of water, which is splashed upon automobile bodies, where it forms white spots when dry, due to the salt dissolved in the water; also, that it is tracked into stores and houses, soiling floors and carpets. For this reason we have had to use it sparingly, and then usually to "rot" or weaken the icy coatings formed after sleet storms or on densely compacted snow and ice, so that snow plows or graders would be able to rip such coatings loose from the pavements. Immediately after sleet storms walks and drives are made safe for travel, until the snow-cleaning machinery can remove the ice, by spreading torpedo sand lightly over them from specially designed wagons and carts.

The problems connected with snow removal and disposal are becoming of more and more importance every year and merit considerable attention, but it will undoubtedly be some years before machinery and methods are perfected which will enable us to meet all the requirements in a practical, efficient and economical manner. Until then every contribution towards the solution of these problems will be heartily welcomed by those who realize the importance of snow-cleaning work in our large cities.



Concrete Street Light Post

This is one of the variations in concrete of a standard three-light design for street light post. It has the common fault of many such posts, whether of metal or concrete, in that the post and the arm are quite too heavy in appearance for the day-lit street. They look too heavy, both because the post takes too much room in the street and because they are so much heavier than the work they are doing requires. They will not withstand a shock from collision much better than a smaller, reinforced post, and so they are really not much more dependable and the loss of one occasionally may be made up by the material saved in using a lighter construction.

The New York State Bureau of Municipal Information

The State Bureau of Municipal Information, operated by the New York State Conference of Mayors and Other Officials, from its office in Albany, is now a year old and should be quite proud of its record.

The number of reports sent to city officials of the state during the year was 1,583, an average of 132 a month. The number of general municipal subjects under research on which reports were prepared was 172. The in-and-out mail of the bureau in eight months was 10,508 pieces.

The bureau is now making a comparative analysis of the 1916 budgets of cities, classified by size, as a basis for comparison of conditions, expenditures, total and per capita, populations, etc.

Two full reports, on street cleaning and on sewage disposal, were prepared and distributed during the summer.

Among the subjects on which minor reports were made are snow and ice removal from sidewalks, sidewalk and curb assessments, billboard ordinances.

WORKERS IN THE FIELD

Tests of Concrete Blocks and Vitrified Brick

The Editor of MUNICIPAL ENGINEERING:

Sir—Comparative tests of paving or other materials ought to establish at least a reasonable basis for comparison. Tests which demonstrate with mathematical precision the known fact that no legitimate comparison can be made between two things have no practical utility for engineers or others who understand the purpose of tests to be to add to the sum of useful knowledge.

In the August number of MUNICIPAL ENGINEERING appeared an illustrated article setting forth the results of rattler tests conducted in part for the purpose of determining the wearing qualities of vitrified paving brick as compared with concrete.

Concrete blocks, composed respectively of mortar concrete, concrete, gravel concrete and crushed stone concrete, were made the size and shape of paving brick.

The brick and the concrete blocks were subjected to a rattler test at 900 revolutions, 1,800 revolutions and 2,700 revolutions for all kinds, and 3,600 revolutions for the brick and a portion of the concrete blocks.

The results show the average percentage of loss in weight at 900 revolutions of the rattler as: Brick, 13.7; mortar blocks, 23.2; concrete blocks, 36.6; crushed stone concrete, 37.5; gravel concrete, 35.7.

At 1,800 revolutions the average losses were: Brick, 20.6; mortar blocks, 41.4; concrete, 56.4; crushed stone concrete, 59.1; gravel concrete, 53.7.

At 2,700 revolutions the average was: Brick, 26.2; mortar concrete, 62.7; concrete, 71.1; crushed stone concrete, 75.5; gravel concrete, 65.6.

It is not necessary to carry the report out to the fourth dimension, as the usual test for paving brick, as required by the American Society for Testing Materials, is 1,800 revolutions at a speed of not less than 29.5 nor more than 30.5 revolutions per minute.

The test under consideration was made with the rattler revolving thirty times per minute, a speed conforming with standardized requirements.

The report of the test shows that at 1,800 revolutions brick had abrasion loss as low as 16.4 and as high as 24.2, with an average of 20.6.

The concrete blocks had a minimum loss of 37.5 and a maximum loss of 63.4, with a general average of 52.65.

It is difficult to understand how a paving material having an average abrasion loss of more than 50 per cent. in weight can be brought into serious comparison for wearing qualities with a material having a loss of only about 20 per cent. of weight, more especially as the maximum allowed loss in weight of brick in a rattler test is fixed at 22 per cent. to 24 per cent. in most of the cities of the United States.

But a test ought to be conducted under true competitive conditions. Brick are as ready to be rattled and laid in a pavement when they are taken from the kiln as they will be after a lapse of time. A brick pavement usually is kept closed ten days or two weeks, but only in order to allow the cement grout to set thoroly.

Concrete is placed in a pavement in a plastic state and a concrete pavement usually is opened to traffic three or four weeks after its completion. At the utmost, six weeks are allowed. As a rule a brick pavement is ready for traffic in half the time required to render a concrete pavement usable at all.

But in the test reported in MUNICIPAL ENGINEERING the concrete blocks subjected to rattler test were allowed to stand for ninety days, or three months, before being tested.

The fact that the brick also were kept ninety days has no significance, as brick do not vary in hardness or toughness after being taken from the kiln. The concrete blocks, however, were given an extraordinarily long time in which to harden before they were put in the rattler. This can hardly be regarded as a test of concrete under service conditions. If the concrete blocks had been tested for abrasion at the expiration of the period at which concrete roads are opened to traffic after being finished, the test would have been more just, as both brick and concrete roads are opened to traffic, and, therefore, they are subject to traffic abrasion, long before ninety days from time of completion.

But under no conditions would an unbiased engineer of competent judgment regard a 52.65 per cent. material as comparable with a 20.6 per cent. material for road surfacing.

In the report of the test under discussion the implication is made that concrete in a pavement wears better than would small concrete blocks, for the reason that concrete pavements are laid in large blocks or slabs.

The implication is justified by the facts; but the argument applies with even greater force to brick in pavements, since a grouted brick pavement is one continuous monolithic slab from end to end, and the individual brick have several times the abrasive resistance of concrete, either in blocks or slabs.

Concrete pavement slabs, on the other hand, are only 25 feet long, the slabs being divided by transverse joints.

Any defects which develop in modern brick pavements can always be traced to weakening of either the concrete foundation or the cement-grout bond. The brick themselves will wear indefinitely—at least for fifty years—without repairs, if the foundation and the bonding material hold. Weakness, if any, always develops in the cement or concrete used in construction.

It is obvious that Mr. Roman's test does not establish a justly comparable relationship between the wearing qualities of concrete and brick as road surfacing materials. The test, as Mr. Roman says, was chiefly valuable as a means of bringing out certain facts relating to the comparative wearing qualities of neat cement, mortar and concrete. So far as the test

determines this point, it is of practical service to the engineering profession.

Nevertheless, the fact that the concrete blocks were fashioned of the size and shape of paving brick, and were tested in competition with brick, indicates that one of the purposes of the test was to determine the comparative wearing qualities of paving brick and concrete. As the result shows that there is really no practicable comparison, on account of the great superiority of brick, it is logical to infer that one object of the test having failed to produce expected results, the secondary results assume prime importance.

These comments are not offered in a spirit of criticism of either Mr. Roman's intent or his results. Mr. Roman is to be commended for undertaking the tests. It is thru the efforts of such independent investigators to ascertain facts and reduce them to a basis of scientific accuracy that the range of helpful knowledge is extended.

In all fields of modern activity scientific inquiry and experiment are needed, nor is the department of highway engineering an exception to the rule.

While Mr. Roman's test has demonstrated the futility of entering concrete in competition with vitrified brick for durability, Mr. Roman did not invent his facts; he merely recorded the results of his tests, as an impartial investigator is in duty bound to do.

F. A. CHURCHILL,
Dunn Wire-Cut Lug Brick Co., Conneaut, O.

Hand Road Oiler Used in Los Angeles County

The Editor of MUNICIPAL ENGINEERING:

Complying with your request I would advise that the Los Angeles county road department adopted the use of a small hand oiler which is part of the equipment of the trucks in the maintenance of paved ways.

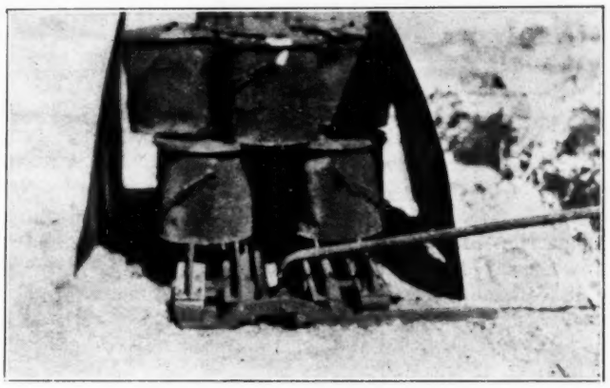
The hand oiler is made of a sheet iron boiler about 2½ ft. in diameter and 3½ ft. long. It has a cast iron pot hanging in the center of the boiler capable of holding 20 gal. of oil. A fire box surrounds the pot, which is used sometimes to keep the oil at a certain temperature. The boiler is supported between 2 iron wheels and is so balanced that the center of gravity is below the axles, thereby always keeping the pot in an upright position. There is a handle on one side of the boiler which is used to move the machine from one place to another.

On the opposite side and on top of the boiler, the hand crank for the oil pump is located. The oil pump is the most important part of the little heater and is fastened to the bottom of the oil pot. The pump is a rotary pump and is driven by a sprocket and chain, which runs to the sprocket on the hand crank located on the top of the boiler. This pump is capable of a pressure of from 6 to 10 lb. The pump is connected with a 20-ft. metallic ¾-in. hose, with a 3½-ft. piece of ¾-in. pipe at the discharge end. The pipe is plugged up with a plug having a slot cut in it so that the oil discharges in a spray. The pipe also has a throttle for turning on or shutting off the oil.

ROAD OILER WITH HEATER AND HAND PUMP.

The oil that is used in the heater is hauled to the various warehouses when hot and is put into 4-gal. pressed steel buckets. The oil cools very quickly and is cold when it is loaded on the maintenance trucks to be taken to the job. When the oil arrives at its destination the buckets are placed in 2 long rows on the ground, one upon the other, so that a fire may be built between the buckets and the oil heated to the necessary temperature.

Up to about 2 months ago wood was used to heat the oil, but at the present time the oil is heated by a distillate and water burner invented by one of our foremen of paved ways gangs. The burner occupies very little room and oil is easily heated in 15 min. to 500 deg. F. during rain or shine. The burner is especially efficient in winter, as it does away with using wet wood for a fire.



HEATER FOR BUCKETS OF OIL.

With this new heater about 80 buckets of oil may be heated at one time. When the oil is heated to between 400 and 500 deg. F., about 15 to 20 gal. are poured into the hand oiler. One man pushes the oiler to the spot to be repaired, another works the pump, and a third man does the spraying of the oil.

On street oiling as much as 125 gallons per hour may be applied. The best results may be obtained from this hand oiler by heating the oil to about 500 deg. By heating the oil to the above temperature it is not necessary to maintain a fire in the hand oiler. A fire in the hand oiler often proves very injurious to the oil pump, as it causes a coating of oil cake to form in the bottom and sides of the pot. This in turn will get into and clog up the pump.

A man, after handling the spraying nozzle, can apply any specified amount of oil to the square yard very accurately. This hand oiling machine, after castings are made, is assembled at our mechanical shop.

I am enclosing photographs of this machine.

F. H. JOYNER,
Road Commissioner, Los Angeles, Cal.

Civic Co-operation in Chicago

The civic co-operation plan of The Industrial Club of Chicago, which as been in operation for a period of more than six months, is believed to be a practical success. About 3,000 citizens are now enrolled, and reports of their activities show that they have been given a continued and practical opportunity for civic helpfulness. No report has yet been made of over-officiousness of any kind. The city authorities are cooperating heartily and practical results are being accomplished. The Industrial Club at its recent annual meeting voted unanimously to continue the Co-operator movement at its own expense. Angus S. Hibbard is chairman of the committee.

FIRE DEPARTMENT

Motorizing the Small Department

The passage of the "Maintenance and Equipment" bill in the state of Kansas has enabled many cities of the second and third classes to take advantage of the new tax levy and invest in up-to-date apparatus for various municipal departments. In many cases new equipment was sadly needed. Statistics for the last year show that 31 towns made the levy, ranging from 0.1 mill up to the limit of 0.5 mill. In fully 50 per cent. of these instances the main object of the levy was investment in chemical cars or combination motor trucks for the fire departments.

The Expense Bugaboo.

Almost every fire chief, however small the department under his supervision, is anxious to keep his equipment thoroly modernized. Some of the difficulties in effecting this ambition were forcefully touched upon by George T. Mohrbacher, chief of the fire department of the city of Marysville, Kan., in his address before the annual convention of the Kansas State Firemen's Association at Topeka last month. He said:

I presume that there are chiefs present at the meeting this morning who have had their share of grief in trying to show their respective city administrations the necessity of better equipment in their departments. The bugaboo of high taxes is invariably held up to prominence and the customary watchdog of the treasury gets busy. If the party who has been elected to any public position on a platform of this nature has succeeded in cutting down expenses without a serious handicap to his constituency or depriving the public of certain improvements and efficiency which they demand and require, the case has so far escaped my notice.

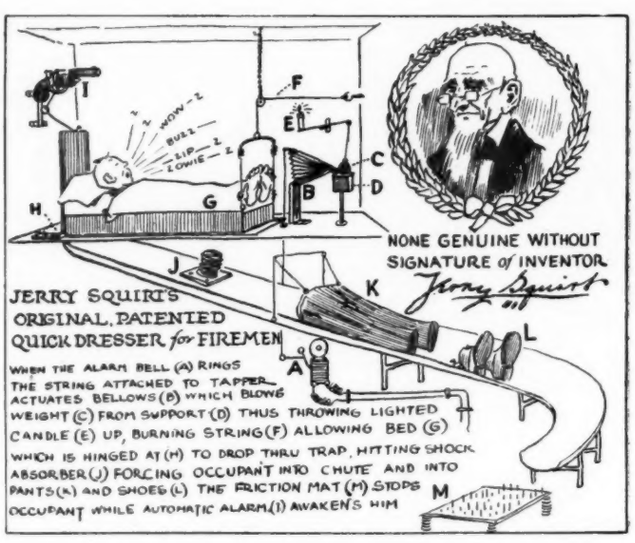
We are living in a day of progressiveness. There's hardly an item or a line but what we not only ask, but absolutely demand the best there is, but I am sorry to say that in too many instances in Kansas the city officials have not seen the light as to fire department equipment and departments are expected to get along with what was purchased when the town was perhaps one-half or one-fourth the size, all to keep the taxes down. The fact that we are burning up $2.55 worth of property for every man, woman and child in Kansas each year is a minor consideration because the people's money has been saved by not squandering any for better fire protection. I do not say that this is the case in many towns in Kansas, but that it does exist in some cannot be denied.

Dependability of Motor Apparatus

At this time when we speak of better equipment in a fire department in a small town we naturally think of motor equipment, either a combination truck, where waterworks have been installed, or a motor chemical in the smaller towns without waterworks, because the experimental stage of motor equipment has long since passed, the auto has come to stay and factories and inventors are vying with each other to reach the stage of perfection as nearly as possible. The objection put up by those who oppose motor equipment on account of impracticability in muddy weather or deep snow is indeed a lame one. True, there are times (and they are exceptionally rare) when it might be impossible to reach a fire on account of extreme mud or snow conditions—but, in such cases it would be just as impossible to get there with any kind of apparatus.

While a motor truck will of course give better service on paved streets than on dirt streets, yet a paved street is not absolutely necessary for its successful operation, and there is as much reason in condemning a motor truck on these grounds as there would be in not building any more houses in the city because some have burned down at some time or other. I do not believe it necessary to comment on the relative efficiency of motor-driven apparatus over horse-drawn as it is a foregone conclusion that the horse-drawn apparatus in fire departments is fast becoming a thing of the past.

This is not only proven by action taken in the larger cities but in smaller ones as well. In Grand Island, Neb., the fire chief's report states that 78 alarms had been answered, at 65 of which the fires had been extinguished with the chemical and the total cost of upkeep, repairs, lubricating oil and gaso-


NONE GENUINE WITHOUT SIGNATURE of INVENTOR
Jerry Squirt
JERRY SQUIRT'S ORIGINAL, PATENTED QUICK DRESSER for FIREMEN
WHEN THE ALARM BELL (A) RINGS THE STRING ATTACHED TO TAPPER ACTUATES BELLOWS (B) WHICH BLOWS WEIGHT (C) FROM SUPPORT (D) THUS THROWING LIGHTED CANDLE (E) UP, BURNING STRING (F) ALLOWING BED (G) WHICH IS HINGED AT (H) TO DROP THRU TRAP, HITTING SHOCK ABSORBER (J) FORCING OCCUPANT INTO CHUTE AND INTO PANTS (K) AND SHOES (L) THE FRICTION MAT (M) STOPS OCCUPANT WHILE AUTOMATIC ALARM (I) AWAKENS HIM
BUZZ
SIP
ZOWIE

(Courtesy of American LaFrance Fire Engine Co.)

line, had been $31.68 for the year, this being the third year for their motor truck.

First Motor in Kansas.

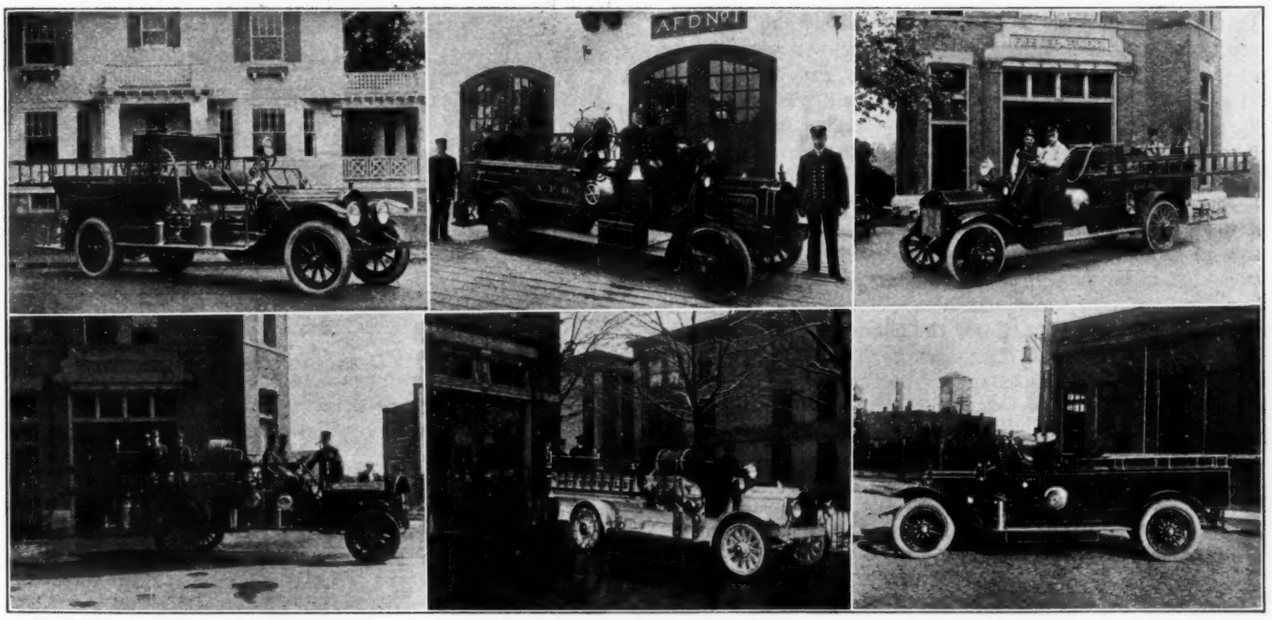
Neodesha, Kan., has the first combination auto-truck shipped into the state for fire department purposes, obtained about 9 years ago. This car has been operated by a volunteer department very successfully since its installation, no paid men are maintained, no one stays at the station. Six or 7 of the 27 men in the department are able to handle the car and in the 9 years they have had the truck there is only one instance in which they failed to reach the fire with it, which was on account of a broken shaft. While Neodesha now has about 6 miles of paving, at the time of the installation of the truck there were none, and as Chief Pingree tells me: "A real piece of fire apparatus will travel any street that can be used for traffic; I don't care how muddy it is." I can cite 2 instances where horse-drawn apparatus has been stuck in the mud, while a motor truck would go right thru, and then come back and hitch on ahead of the horse-drawn apparatus and pull them out.

Good Volunteer System.

Fredonia is another town that has successfully handled the auto-truck proposition for a period of 3 years with a volunteer department. The reason I am quoting volunteer departments is that I take it "Motorizing Small Town Departments" means where paid men could not be maintained, it either not being necessary owing to the infrequency of alarms or on account of the expense. Chief Wolever of the Fredonia department says: "We certainly think it the only thing." In this department two men are detailed to look after the care of the fire station and apparatus for a period of two weeks at a time—they are notified by card when their duties are to begin and are responsible for the apparatus, etc., being in first class condition and that everything is in readiness in case of an alarm. This does not necessitate their staying at the station, neither does it take much of their time, and the result is that every member of the department feels a certain amount of responsibility, which we sometimes find lacking in departments, and a greater amount of efficiency is attained.

Personally, I am very favorably impressed with this system. There are a number of towns in Kansas that are falling into line. Liberal, for instance, away out in the short grass country, has installed a truck in the last few months. Hiawatha is doing the same. Seneca contemplates the installation of a triple combination and expects to render service in the surrounding country when advisable. This same idea of service in the country is being successfully handled in a small town in Iowa and has been for several years.

To sum up the advantages of a motor truck we have: speed in reaching the fire; condition of the men on arrival—I would rather have 2 men to start on a fire who rode to it than 10 men who arrive winded and exhausted from having pulled hand-drawn apparatus from the fire station; greater amount of equipment carried; no waiting for the hook and ladder trucks or hose cart to arrive, as everything that is necessary is carried on the 1 truck and the chemical is worthy of special comment. You chiefs who are getting along with the hand-drawn apparatus and no chemical, think of how often a small fire inside could have been put out had you had a chemical, perhaps a few gallons would have done the business, but you are compelled to turn in your fire hose and at least a hundred gallons of water, doing 10 times the damage with water that the chemical would have done. Think of the difference in damage in a private residence, a stock of dry goods of clothing, or for instance, in a drug store, between going in with a small chemical hose or turning water into the same place. Statistics show that about 85 per cent. of the fires are extinguished with chemicals.



WHITE 5-TON FIRE APPARATUS, EQUIPPED COMPLETE WITH LADDERS, HOSE AND CHEMICAL TANKS, OPERATED BY THE FIRE DEPARTMENT OF THE CITY OF QUINCY, MASS.

STEGEMAN 2½-TON FIRE TRUCK, EQUIPPED WITH HOSE, CHEMICAL TANK AND HOSE EXTENSION LADDERS, OPERATED BY THE FIRE DEPARTMENT OF THE BORO OF RANKIN, PA.

PACKARD 2-TON CHAINLESS FIRE TRUCK, EQUIPPED WITH HOSE, CHEMICAL TANK AND HOSE EXTENSION LADDERS, AXES AND OTHER PARAPHERNALIA, OPERATED BY CITY OF ALMEDA, CAL.

PACKARD 3-TON CHAINLESS FIRE TRUCK, EQUIPPED WITH HOSE, TWO CHEMICAL TANKS AND HOSE, EXTENSION LADDERS AND MISCELLANEOUS PARAPHERNALIA, OPERATED BY THE BORO OF SOUTH BROWNSVILLE, PA.

STEGEMAN 1½-TON FIRE TRUCK, EQUIPPED WITH HOSE, EXTENSION LADDER AND SEARCHLIGHT, OPERATED BY FIRE DEPARTMENT OF THE CITY OF COLUMBUS, WIS.

WHITE 5-TON FIRST-AID FIRE TRUCK OWNED BY PEOPLES GAS, LIGHT & COKE CO., CHICAGO. ANSWERS ALL FIRE ALARMS, EXPLOSIONS, SUICIDES AND OTHER EMERGENCIES. COVERS ENTIRE CITY AND MAKES NO CHARGE FOR ITS SERVICES.

Pays to Buy Standard Goods.

Considerable discussion as to the kind of apparatus to buy is going on over the country, that is, standard apparatus. By this I mean that which is turned out by the factories specializing along that line, or the buying of a chassis of any good heavy car and having it equipped at home. I do not feel that I am in a position to pass judgment on this proposition, to recommend the one and condemn the other, but in my experience in other lines of business I have always found that it pays to buy from the man who specializes. In other words, it is reasonable to believe that the man or men who make a study of any certain problem or proposition will come nearer reaching the desired result than where it is partly or all experimental.

The principal thing in fire apparatus motorization should be the high powered car, not so much for speed on the race-track street, but ample power to apply at the right time. A maximum speed of say 30 miles per hour is all that should be necessary; faster than this endangers the life of the firemen as well as citizens on the street, and the apparatus. Some towns have bought the chassis of a good heavy car and mounted the equipment at home very successfully, and it is not for me to say that this is not good judgment. Also in some cases the funds for the purchase of standard equipment have not been available and a cheaper layout would have to be used. This is commendable and in my mind should be encouraged rather than to have the same department get along without the better facilities.

In some cases where I have had the opportunity of discussing this subject with parties interested, the principal objection to motorizing was the expense of maintaining a paid man or two for the handling of the apparatus. In this respect a number of ideas have suggested themselves.

Combination Chauffeur and City Clerk.

In the average town of from 1,500 to 4,000 the duties of the city clerk are not enough to take more than a small portion of his time and these appointments are consequently often given to an older man or to some one who perhaps is incapacitated from other work and at a salary ranging from $150 to $300 a year, which is paid out of the general fund of the city. In such cases and where motor equipment is installed in the fire department, appoint some man who is qualified to do the work of the city clerk and who can also look after your motor truck. You of course will have to pay a man of this kind more money, and you should expect to, but take the amount the other man has been getting, say $20 or $25 per month and add $40 to it and you'll find the good material anxious for the job. And if the general fund won't stand it, charge it all to the maintenance fund, after you have your equipment, and they'll have $300 more in their general fund. I wouldn't expect the city clerk to take care of the house at night. Let the night marshal do it. Or better yet, any one of 4 to 10 members of the volunteer department would be only too glad to sleep at headquarters in a room furnished free of charge.

Cost of Maintenance.

As regards the expense of the upkeep of the car, lubricating oil, gasoline and ordinary repairs for a motor truck in a small town, most of us are carrying too many men in our departments. If you are allowed 35 or 40 men, all exempt from poll tax, chances are that there are 15 or 20 that are always on hand when an alarm is sounded. By cutting your department down to 10 or 15 men the amount of extra poll tax going into the city treasurer will more than pay the bill of upkeep for the car. Some will say that you must have a steam-heated building to keep the car in. The principal expense in most cases would be the installing of the heating apparatus, as most cities have no adequate building, after which the amount of coal burned would be very little more than is used in the 2 or 3 stoves used. Quite often it is possible to keep the truck at a convenient garage where heat is installed and where drivers are handy day and night in case they are needed. But if this is impossible a small electric heater can be used under the hood of the car or anti-freeze can be used in the radiator.

In conclusion, let me say, that there is no reasonable excuse for the departments in the smaller towns not having motor equipment. Talk it over with your city officials and citizens, show how little it will cost each individual and what the benefits will be in greater efficiency. Then, and not until then, can we expect a cutting down of our insurance rates.

Norwich Deputy Gets There Quick

Norwich, Conn., not being large enough to have attained the dignity of a permanent department, was for a long while confronted by a serious problem in the matter of getting its deputy chief to fires. The deputy is not a permanent man, and, when not on fire duty, is employed in a local factory, about two miles from the center of the city.

Norwich, however, was fortunate in possessing a public-spirited citizen in the person of C. V. Pendleton, Jr., who volunteered to take the chief to fires in the side car of his Indian motorcycle. The deputy accepted the offer with alacrity and Mr. Pendleton got busy. He commenced to pick the deputy up

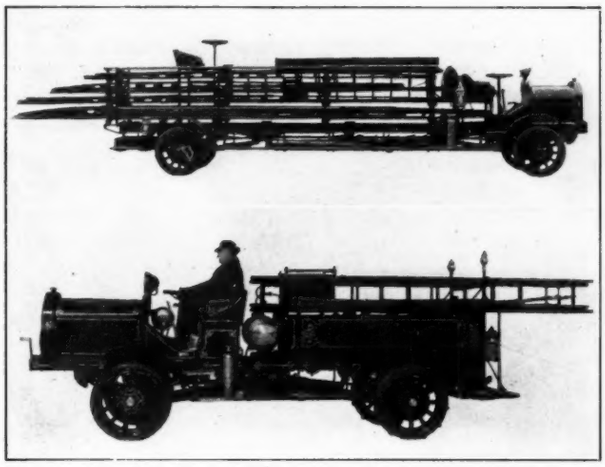
whenever an alarm sounded, and not infrequently landed him at the scene of the fire before the rest of the department had time to put in an appearance. In fact, his work in this direction proved so good that in a short while the city government hired him to do it regularly, giving him the right of way over traffic and the right to run thru the city streets with his cut-out open. In the past three years the outfit has responded to over 200 bell alarms without a single accident or delay in reaching the fires.

Motor Apparatus in Somerville Fire Department

With the installation of the new Ahrens-Fox chassis, equipped, furnished and fitted up in the department's machine shop, four of the eight stations of the Somerville, Mass., fire department will be fully motorized, according to the report of Chief Sewall M. Rich. The motor apparatus includes, besides the above, a ladder truck, three combination chemical and hose, a tractor-drawn engine, a supply and wrecking wagon and two cars for chief and assistant.

Snow Test for Holland Trucks

Possibly the heaviest snowfall ever recorded in Holland, Mich., occurred late last March. The snow was wet and heavy; stuck to everything it touched. Local street-car service was greatly delayed and even the railroads experienced difficulty in getting into town. Traffic was impeded everywhere, and it was generally agreed that a better time to test the new Duplex motor fire trucks could not have been desired.



Fully thirty persons were taken aboard and Holland's first motor fire truck started out to convince the skeptical of that town of well-known conservatism. It tore its way at full speed thru the soft sand and packed snow of the city's outskirts, surmounted the hills without slackening and plowed thru the tightly-packed heaps which had been shoveled into a long windrow the full length of Eighth street, where the merchants had had shovelers at work. Thus the conservative town of Holland was won over to strictly modern and efficacious fire-fighting apparatus. Possibilities of slightly greater initial expense no longer weighed in comparison to visual achievement in a test like that.

The truck in question is a 4-wheel drive combination chemical and hose apparatus, with a pumping attachment. It has a hose capacity of from 1,500 to 2,000 ft.

The accompanying photographs illustrate similar Duplex apparatus, the upper view being that of a 3-ton hook and ladder truck, and the lower that of a 3-ton combination chemical and hose truck.

Successful Chemical Pumper Test

At a recent test of the Thomas automatic chemical pumping engine at Buckeye Lake, near Newark, Ohio, the complete efficiency of a chemical hose stream for putting out fires was again demonstrated. This is one of the most interesting tests yet conducted by the Thomas Automatic Fire Engine Company.

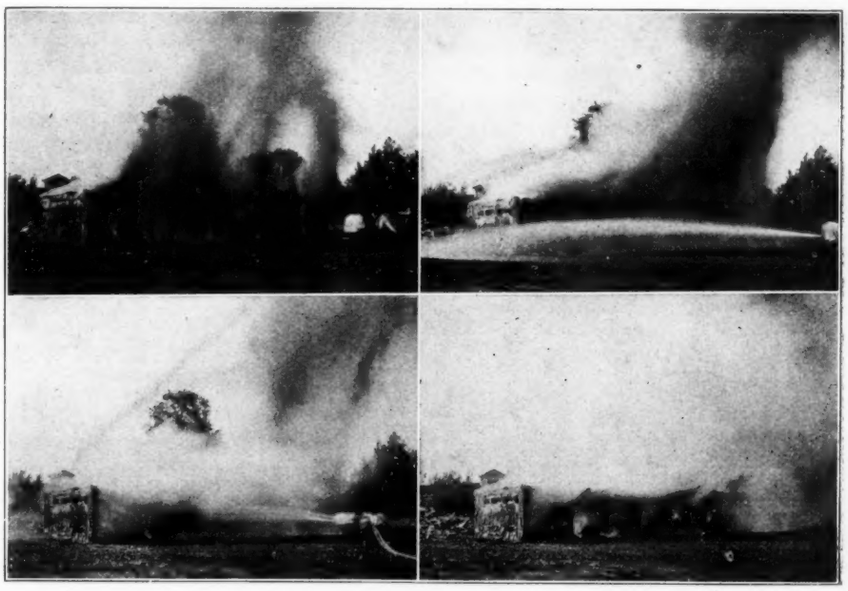
More than 12,000 cu. ft. of combustible base was fired in five places and permitted to burn six minutes, thus insuring an exceedingly hot fire, before the chemical stream was turned on. The fire was extinguished within ten seconds with plain soda water, thrown at fire pressure.

The structure burned was 100 ft. long, 12 ft. wide and 10 ft. high, inclosed on one long side and on both ends, and roofed with old iron. Thirty wagon loads of old pine siding and sheeting in various lengths were placed in stalls,—many of them standing on end, thus filling the whole interior of the building with highly combustible material so arranged that free ventilation was provided for the flames. Further than this, a large quantity of excelsior was distributed thruout the piles of lumber, together with old, dry barrels and boxes. The entire contents were completely saturated with 100 gal. of kerosene, the object sought being not only to show a burning building, but especially to ensure a tremendous volume of heat and blaze at a very high temperature.

When fired in 5 places, the 12,000 cu. ft. of combustibles instantly became one mass of flames, which after burning 6 min., developed an estimated minimum heat of 1,400 deg.

The soda water was turned on at the rate of 200 gal. per min. and, as before stated, completely extinguished the flames within 10 seconds. The pipemen started at the left and kept the stream moving to the right. The actual amount of water used was 60 gal., chemicalized with 6 lbs. of plain baking soda. Pump pressure was 120 lb. and 80 lb. at the 1¼-in. nozzle. The volume of soda water was one-third the capacity of the engine.

The efficiency there demonstrated staggers all calculations of chemical authorities. According to recognized chemical laws and a 15 per cent. air diffusion of carbon dioxide gas, 144 lbs. of soda and 576 gal. of water would have been required to do what was obtained in practical application of 6 lb. of soda and 60 gal. of water. Or, if this stream of soda water extinguished 12,000 cu. ft. of fire in 10 sec., 72,000 cu. ft. could have been put out in one minute. The capacity of the engine would have extinguished 3 times the amount of fire in 1 minute, or 216,000 cu. ft.; the equivalent of a building 1,800 ft. long, 12 ft. wide and 10 ft. high.



Electric Fire Vehicles Increasing

"The advantages of electrically-propelled fireapparatus are rapidly being appreciated, and many municipalities both here and abroad are electrifying their equipment," writes A. Jackson Marshall, secretary of the Electric Vehicle Section of the N. E. L. A.

"About a year ago the fire and police commissioners of Paterson, N. J., realized that additional fire apparatus was necessary to increase the efficiency of the fire department, and it was decided to completely motorize the department. Following the wholesale conversion of electric fire apparatus in

Camden, N. J., the city of Patterson, N. J., made a thoro investigation and some rigid tests, which demonstrated to them the fact that the electric has quick get-away, hill-climbing ability, simplicity of operation, economy and general reliability.

"On the strength of these tests an order was placed for 2 steam fire engines with 2-wheel front-drive electric tractors, four 2-wheel front-drive tractors, 5 electric combination chemical engines and hose wagons, and one 85-foot 4-wheel drive electric aerial truck. Charging apparatus for each engine-house was also ordered.

"Another example of the success of electrically-propelled fire apparatus is the installation in Grand Rapids, Mich. The fire department in this city has 6 pieces of electrically-driven apparatus—5 ladder trucks and 1 steam fire engine. The department reports that its electric apparatus has proven absolutely dependable at all times, the upkeep expense has been very light, and it has been generally satisfactory. The district thru which these engines and trucks travel is very hilly and in every instance the electric apparatus has proven its value.

"Some of the other fire departments using electric apparatus are those of Philadelphia, Brooklyn, Akron, Ohio, and Springfield, Mass., and all are fully appreciative of the electric's dependability and economy. Battery-propelled fire apparatus is also used extensively in Germany and England."

New York Calls for "Double Duty"

The city of New York has just ordered 10 pieces of motor-driven fire apparatus from the South Bend Motor Car Works, South Bend, Ind., the first "Double Duty" equipment to be installed in that city. The purchaser calls for 7 hose wagons, 70-h.p. each, equipped with the regular New York standard turret-pipe, and 3 combination wagons of the same h.p. rating, equipped with double 35-gal. chemical tanks and hose bodies, carrying 1,200 ft. of hose and 300 ft. of chemical hose.

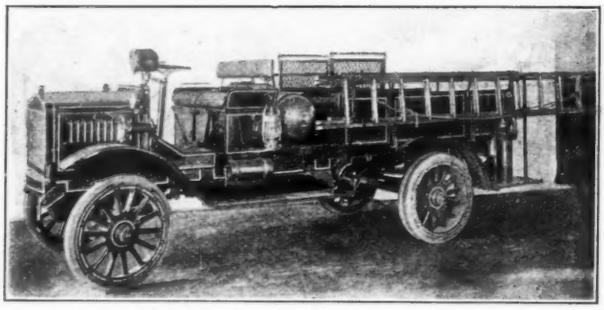
All of the 10 pieces of apparatus are to be fitted with solid tires, dual rear, and the regular "Double Duty" chain drive.

The city of Three Rivers, Mich., also recently purchased a 6-cylinder, 95-h.p. Double Duty combination fire truck, equipped with the old horse-drawn apparatus, which has been in local service for more than 20 years past and is still in good condition. This car is to be fitted with 38 by 7-in. pneumatic tires on all 4 wheels and has a speed of 50-mi. per hour. The car was driven overland from South Bend to Three Rivers, having as its passengers a member of the Board of Public Safety and the major himself.

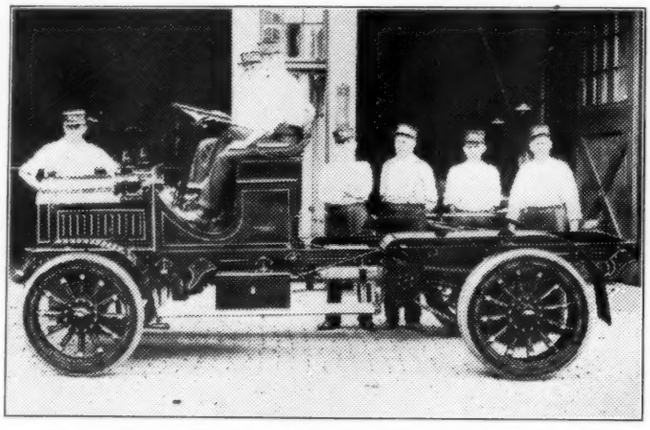
The city of Greenfield, Ind., has just received a 4-cylinder Double Duty combination chemical and hose cart, equipped with cushion demountable tires. It has a speed of 40 mi. per hour.

Texas Fire Chiefs Using Wichita

Georgetown, Hamlin and Hereford, Tex., are now operating 3½-ton Wichita combination hose and chemical motor-driven fire truck on the order of that herewith illustrated, which is owned by the first-named municipality. Wichita hose and

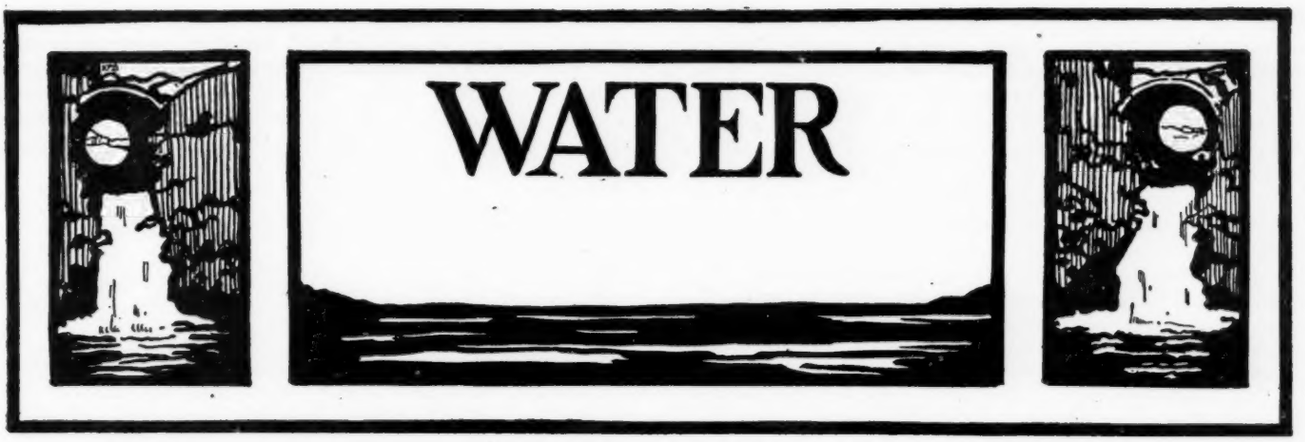


chemical apparatus tractors also have lately been installed by the fire departments at Texarkana, Tex., Anadarko, Okla., Seymour, Tex., and Calvert, Tex.



U. S. TRACTOR, FIRE DEPT., CITY OF COVINGTON, KY.

JEFFERY QUAD FIRE TRUCK RECENTLY SOLD TO THE EAST YOUNGSTOWN (OHIO) AUTHORITIES BY JONES & SAXTON. W. N. SAXTON IS STANDING IN FRONT. THOSE ON THE SEAT ARE COUNCILMEN G. N. REED AND DAN FERRIS. FIRE CHIEF GILBRIDE, COUNCILMAN DIXON AND CITY CLERK ANDERSON ARE SEATED ON THE TRUCK.



Scotch Method of Cleaning Water Mains

Water mains lose capacity because of the formation of incrustations upon the inner surface and by sedimentary deposits. Both reduce the effective cross-section and increase the friction. Perhaps the formation of incrustations is the more important of the two. The reduction in capacity may become very great. A loss of 30 or 40 per cent. is not at all unusual. The modern remedy for such conditions is to clean out the mains. There are American methods of doing this, but it is the purpose of this article to give an account of a Scotch apparatus and the methods of using it.

The city of Ayr, in Scotland, derives its water supply chiefly from a lake in the neighborhood of the headwaters of the Doon river. This lake, Loch Finlas, is some twenty-odd miles to the south of Ayr. The supply is conveyed by a main 17 miles long to a service reservoir near Dalrymple which has a capacity of 7,000,000 gallons. For 2½ miles the main consists of 18-inch fire-clay pipe. The gradient of this stretch is 1 in 350. All the rest of the main consists of cast-iron, coated pipe. For 8 miles this main has a diameter of 16 inches and for 6½ miles, of 14 inches.

Scraping Cast-Iron Mains.

It was determined to scrape the cast-iron sections. The consideration impelling to this determination was the necessity of quickly increasing the water supply some half million gallons per day. It was hoped that this increase might be realized and the laying of a new main deferred for a time. The main was laid in 1887 and was calculated to have at that time a capacity of 2,592,000 gallons per day; but whether this calculation was ever verified is doubtful. However, in 1903 the measured capacity was found to be 2,037,000 gallons, and for 1911 the capacity was determined to be 1,865,000. It would seem that there had been a total loss of some 727,000 gallons daily. It was not unreasonable to anticipate, in view of these figures, that cleaning might restore the main to a condition equal to the necessities at the moment. This hope was fully realized. In fact, the capacity determined subsequently to cleaning was found to be within 46,000 gallons per day of the original calculated capacity.

Cleaning is supposed by some to promote incrustation afterwards. Granting this, the cost is not great, especially when proper provisions have been made in the pipe line, and cleaning may very well prove economical.

Cost of Scraping.

The cost, as reported by Mr. Jas. Macfazdean, assistant burgh engineer, Ayr, is divided between the 14-inch and the 16-inch lines and includes in both cases certain apparatus of a more or less permanent character. For the 14-inch pipe, 6.43 miles, the total expense was $1,061. and for the 16-inch pipe $1,926, or a grand total of $2,987. The apparatus cost for both sections amounted, however, to $2,091. It will be seen from these figures that the actual cost really chargeable against the one cleaning is no great amount—perhaps $1,200 (including depreciation, etc.), or $82.76 per mile. In the United States, these figures would doubtless be increased somewhat because of the presumably higher cost of labor.

A sample of incrustation from the main was subjected to chemical analysis with the result that 70 per cent. was found to be peroxide of iron. A much smaller percentage (2.57) was protoxide of iron. The carbonic acid percentage was 1.12. Water and organic matter accounted for 24.42 per cent. The remainder, totaling less than 2 per cent., was divided amongst several inorganic compounds. It will thus be seen that fully half of the incrustation came from the pipe. The water itself contains no iron. It is quite soft. Its analysis may be of practical interest, as affording a means of comparison:

	Grains per. gal.
Total solids in solution	3.92
Chlorine	0.84
Sodium chloride equivalent	1.38
Ammonia (free)	0.0035
Ammonia (albuminoid)	0.0055
Oxygen necessary to oxidation of organic matter	0.42

The total hardness is estimated at 0.84 degrees.

It was decided to scrape the 14-inch section first. This decision seems now to be regarded as wrong, as that section was the lower part of the line. With the 14-inch main cleaned, the resistance to the oncoming water from the 16-inch pipe was so much less than with the smaller pipe uncleaned, that the pressure was reduced below proper working conditions in certain places, as described below.

Description of Process.

The whole line of cast-iron main was divided up into sections containing 1 or 2 miles each and hatch boxes were placed in position at the points of division. The bends were disregarded. This was permissible for the reason that the minimum radius of curvature was 18 feet. In placing hatch boxes, it is important, as Mr. Macfazdean points out, to take into account the disposal of large quantities of water in such wise as to effect no damage or inconvenience. These boxes may require to be left open for quite a number of hours, so that it is not permissible to locate them just anywhere. There will be an excavation, of course. It may seem advisable, in built-up sections, to wall these up and otherwise provide for permanence and accessibility. It is suggested that it is undesirable so to locate a hatch box as to have back drainage from any considerable length of pipe. Further, it is of importance to be able to control the water entering a given section at a point near the beginning of that section.

In the present case, the difficulties to be cared for were somewhat simplified because the main itself discharged into

a reservoir containing nearly a three-days supply. The hatch boxes were placed, two at a time, every other day, under a requirement that water was to be shut off for no longer than 6 hours per day. There was only one considerable departure from the time requirement, and this was due to flood from the river.

The method of cleaning is briefly this. The hatch box is opened up and the scraping device put in place, when the lid is securely bolted on. Upon turning on the water, its forward impetus, operating against the pistons of the device, will serve to drive it ahead. Scrapers suitably disposed are carried along and perform their duty upon the incrusted surface of the pipe. The pressure was reckoned as a hydraulic head of 15 feet. There were two places where this head could not be relied upon, so that here hatch boxes were placed at either end of each of these short sections, so that the scraper could be hauled thru by means of a line.

Prior to the cleaning of a section, the water is cut off from its length and a complete drainage effected. The hatch box covers are lifted off by means of a suitable derrick or other device, and the scraper is lowered into position in the upper box.

In a section about to be scraped, the main valves should be opened wide to avoid hindrance to the scraper. In order to prevent filling of service pipes with debris from the scraper's activity, they are to be shut off. As the air valves must be left open, they should be cleaned out after the work is over.

There will be a heavy discharge of water thru the open hatch box at the far end of the section. A plug is put in place at one end where the hatch box opens into the section of main next to be cleaned. Thus is prevented the washing of debris into that section. In the American system, a riser pipe is put in place at the far end of a section. This is inclined to the vertical and serves to throw the water out upon the general surface.

MACHINE FOR CLEANING WATER MAINS IN PLACE IN SPECIAL BOX CONSTRUCTED IN THE MAIN FOR THE PURPOSE OF INSERTING AND REMOVING THE CLEANING MACHINE. A COVER IS BOLTED TO THE BOX WITH A WATER-TIGHT JOINT.

STETHOSCOPES IN USE TO TRACE MOTION OF CLEANING MACHINE THRU THE PIPE. AS THE MACHINE PASSES EACH MAN HE WALKS QUICKLY TO THE OTHER END OF THE LINE OF OBSERVERS SO THAT THE LINE OF MEN ROLLS ALONG THE ROAD AT SAME RATE THAT THE MACHINE TRAVELS.

The scraper used on the 16-inch main weighed about 335 pounds. Going thru the main it had an average speed of perhaps 2 miles an hour with a 15-foot hydraulic head back of it. It will be seen from this that the actual normal cleaning operation is by no means protracted. There were no very steep climbs taken by the scraper. There was one incline of 1 in 9½, 980 feet long, and no difficulty whatever was experienced in negotiating it.

The lower hatch box and its excavation must be pumped out after the work is over.

After the scraper arrives at the hatch box, which is its destination, the water is shut off. It is judged important to do this quite promptly, if the drainage from this point is not good. As the scraper passes the successive scour valves they are shut off. When the scraper has finished the section, these valves are opened up again. In order to get word back to the point of water control at the head of the section when the scraper finishes, a field telephone may be employed. Or, as in the present case, a system of signalling may be used.

Locating the Scraper.

When the scraper finished its first trip thru a section, it was hauled back for a second. In this way, each section was given two cleanings without any delay between.

When the scraper is working its way between termini, it is very important to have some adequate means of locating it. It may, in fact, encounter an obstruction which it is incapable of passing or carrying along. There are ways of stirring it into activity, but these sometimes fail, when the only alternative left is to excavate down to the main and cut out a short length where the scraper is or else quite close to it. There are two principal methods of keeping track of the apparatus. One, employed in the United States, and perhaps elsewhere, is to attach a line to the rear end. The length of line at any moment will indicate the advance of the machine. Another method is to follow the ongoing apparatus by sound. Sometimes the noise is able to penetrate to the surface and reach the ear of an attendant workman without the aid of a special apparatus. At other times, a kind of stethoscope is employed. In this case, a number of men will set up the

THE PILE ON THE LEFT SHOWS THE AMOUNT OF MATERIAL, TUBERCULATION, SCRAPED FROM 6,600 FEET OF 14-INCH MAIN. THE COVER OF THE BOX FOR INSERTING THE MACHINE IN THE LINE IS SEEN SUPPORTED OVER THE HOLE DUG DOWN TO THE BOX.

stethoscope at short intervals. When the slowly moving scraper passes the rear man he goes forward and sets up his instrument at the head of the line, and so on.

If the machine stops, it may at times be persuaded to resume by means of an induced water hammer. Presumably this is effected by a quick shutting off of the water and a quick subsequent release. Sometimes a mere jarring of the main will be sufficient; at others, a wisp of hay floated down to the rear end of the scraper may be successful in getting it going again.

Results of Cleaning.

The two portions of the cast-iron main were cleaned one year apart. The 16-inch main was originally laid in order to get a flow over high ground that was located in the first 8 miles. When the 14-inch main was scraped and its capacity restored, the pressure line at the junction fell to such an extent that at one point it was no higher than the pipe itself. The result was that the remainder of the line became nothing more than a series of inverted siphons and certain consumers were cut off from their supply. This condition required the closing down of some of the valves and a consequent throwing of the pressure back on the main behind. In consequence, the natural advantages of the cleaning operations upon this 14-inch section were not secured until the 16-inch section above was cleaned one year later.

The capacity was then almost fully restored to its original theoretical amount.

After a period of two years subsequent to the completion of the scraping, a capacity test was tried with the result that 40.5 per cent. of the gain was found to have been lost. In other words, in two years—or possibly we should call the interval something over two years because of the early cleaning of the 14-inch main—the interior condition was two-fifths as bad as before scraping.

It would seem that the necessity of a yearly cleaning, or even a more frequent one, is indicated. The actual cost of cleaning is not great, once the hatch boxes have been built into the line and walled-in excavations provided. In the present instance, the scrapers themselves were purchased, one for each size of main. New leads and leathers are necessary for each cleaning operation.

The incrustations in the pipe line were due to an oxidation of the iron, presumably at points left exposed by some imperfection in the coating process. Apparently, a nodule grows upward and radially from this center, while a corrosive activity goes on downward into the metal and over the surface beneath the growing nodule. Layer grows upon layer, causing the nodule to project more and more. The spread of the corrosion on the metallic surface undermines the coating. A nodule cited by Mr. Macfazdean had a diameter of 1½ inches. The central decomposition of the iron was 3/16 inch deep and the general decomposition 1/16 inch. The coating and the iron were sound beyond the area covered by the nodule. Apparently, there is a somewhat regular increase of the corrosive effects while individual nodules continue distinct. Upon their coalescence, however, and the formation of a continuous layer of incrustation, corrosion slows up. There is reason to think that it will cease altogether when the coating of incrustation has reached a definite thickness, presumably different for differences in conditions as respects the chemical constitution of the iron and the water.

It will be of interest to add here that one main at least is known in which cleaning is done regularly year by year, where the loss of capacity and restoration are also regular and equal in amount. That is to say, during the year the capacity falls off, but is fully restored by the cleaning operation. This would not appear to bear out the idea that the pipe requires more frequent cleaning because of the cleaning itself.

It seems that some trouble has been experienced with having the plug at the lower hatch box driven up into the main ahead. A method of avoiding this difficulty has been to use a scoop in the pipe over the plug. It seems that a "fish cutter" has proved serviceable in preventing the scraper from sticking in the main.

How Wilmington Set 10,000 Water Meters

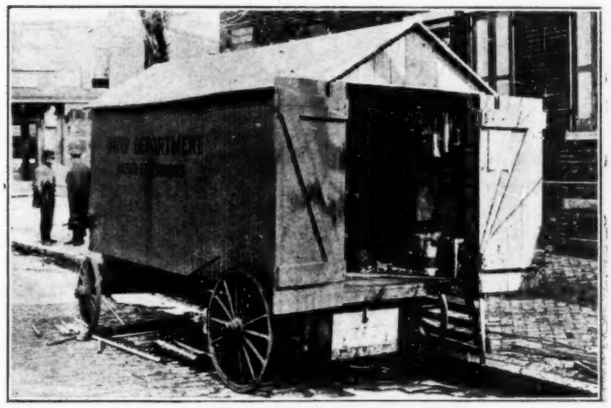
By S. N. Van Trump, Assistant City Engineer and Superintendent

Prior to May, 1914, only about one-half of the 21,306 water services in the city of Wilmington, Del., had been metered, but beginning with that month the board of water commissioners authorized the project of a pan-city installation, and work was at once undertaken.

By the close of the year the project was about 94 per cent. completed, and the result of this policy is being manifested today by decreased consumption of water. As yet the meters have not been sufficiently long in service to obtain exact statistics, but the following data are of interest as indicating approximately the effect of this work:

Total decrease in pumpage for year.....641,054,900 gallons
Decrease in manufacturing consumption...296,397,288 gallons

The decrease in manufacturing consumption was due to general business depression, but this cause is not fairly applicable to domestic consumers. With the exception of a few special industries, Wilmington has experienced an unprecedented era of prosperity, and under such conditions the do-



PIPE AND METER SHOP.

mestic consumption would naturally tend to increase. This is especially true under the present system of meter charges, where water rents are paid yearly in advance and carry an extremely liberal minimum allowance.

In the light of the rather limited data available at present, it seems reasonable to state that a large percentage of the decrease in domestic consumption is due to the moral effect of

INTERIOR OF PIPE AND METER SHOP.

installing meters, combined with the department's firm ruling that extravagant non-metered or schedule consumers must pay for water by meter measurement.

The total decrease in domestic consumption, as indicated above, is equivalent to nearly 1,000,000 gallons per day (944,000), but how long this decrease may continue is problematical in view of the extremely rapid growth of the city.

Service and Meter Extension.

During the year a total of 819 new services were connected to the distribution system, and 336 old services were renewed. In addition, 92 parts of services were installed where repairs and replacements were necessary.

The total number of services in use at the end of the year was 21,306, of which 19.3 per cent. were metered. The total number of meters installed during the year was 9,948, of which 768 were replacements of damaged or broken meters and 9,180 were new installations. In addition, 170 meters were repaired in place.

The work of metering every service in the city is being rapidly pushed to completion, despite the fact that all consumers are not required to pay by meter rates (unless extravagant in the use of water) during the work of revising the existing schedule of charges. A subdivision of the total number of new meter installations (9,180) shows that 5,125 were set in cellars, and 4,055 at the curb.

In this connection it is interesting to note that the Department was confronted with the question of deciding on curb or cellar settings, when plans for metering the entire city were under contemplation. After carefully considering the advantages of curb installations, and the additional expense necessitated thereby, the problem was solved by adopting the following policy:

1. Meters to be set at curb on all new properties.
2. Meters to be set at curb on properties without cellars; except where the probable life and nature of the building did not warrant the expense of a curb setting.
3. Meters to be set at curb when requested by property owner.
4. Meters to be set at curb where danger of freezing existed, if installed in cellar or where cellar did not permit of convenient location from meter reader's standpoint.
5. All meters not covered by above stipulations to be located in cellars.

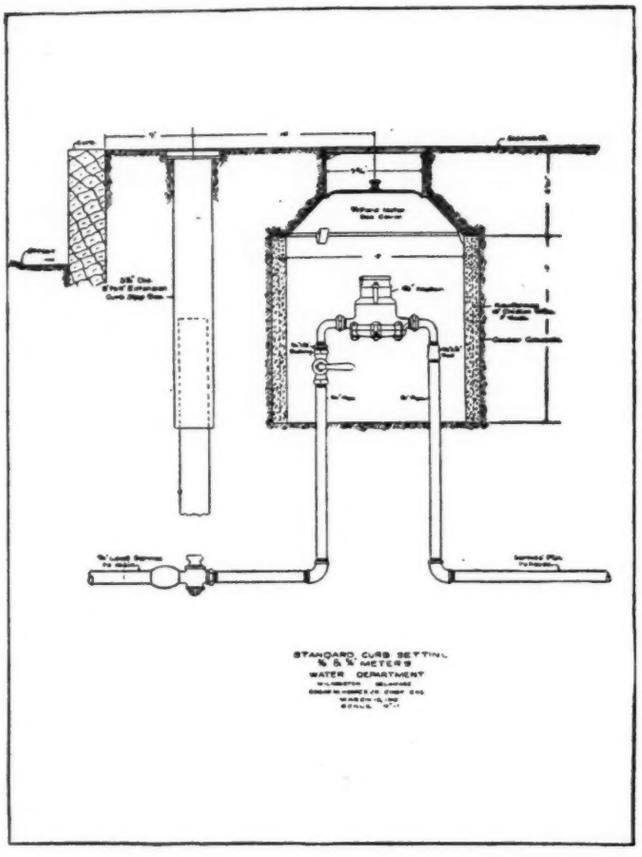
The practical results of the above policy have been entirely satisfactory to the Department and the property owner.

How Organized and Equipped.

The first step in establishing a working program was to subdivide the city into 5 installation districts and to work each district individually and in the order decided upon. The force engaged on the work varied from time to time, but conformed on the average to the following schedule: 1 plumber; 7 pipe fitters; 8 helpers; 2 pavers; 2 drivers; and from 10 to 20 laborers. The equipment comprised a cart and horse, a motor truck and a street shop wagon. (See illustrations herewith). Under the direct supervision of the engineering department, the plumber acted as the foreman of the working force. All employees reported each morning to the street shop wagon, which was located at the point of starting the day's work. The necessary equipment of tools and supplies was contained in this wagon, depletions of stock being filled daily from the main store room, by use of the auto truck.

Plan of Operation.

Slips were prepared each day at the main office, contain-



November, 1916

ing the street number of every house in the district in which the force was working, and a notation as to whether or not the house was already metered. These slips were distributed to the fitters at the start of the day's work, and were turned in to the foreman as the meters were installed. They were then approved by him, and returned to the main office for the purpose of permanent entry in the department's books. In addition each fitter was required to enter on a printed form a report of each meter installed, with its location or notation of any service complications or other reason preventing its installation.

When such complications existed, the fitter's report was returned to the engineering department, and the property owner notified by letter to remedy the condition within 30 days. At the expiration of this time an inspection was made, and if the situation had been corrected, the meter was ordered installed.

In cases where the property owner failed to comply with our requirements, the contract for a supply of water to such property was cancelled. In this connection it is important to note that service complications existing between the main and curb line were taken care of by this department, while those existing between the curb and building line were corrected by the property owner. It is also interesting to note that before any meter was installed, and prior to making an inspection for such purpose, the tenant of each house was supplied with literature explaining the nature of the work, and the benefits resulting therefrom.

Progress and Cost of Work.

From May 8 to June 30, 1914, 1,233 meters were placed, of which 239 were curb and 994 cellar installations. From June 30, 1914, to July 1, 1915, the number of installations was 9,180 of which 4,055 were curb and 5,125 cellar settings. Thruout the winter the work was continued without interruption, the working force being confined to cellar installations during periods of bad weather.

The average cost of installing ⅝-inch meters at the curb, including meter, meter box, top, pipe and fittings as shown in the illustration of the department's standard installations, was $12.85. This price includes the cost of repaving, but not the cost of the curb stop box or curb stop. The average cost of installing meters in the cellar or other inside location was $8.55 including all necessary labor and material.

The standard meter box (Ford) is of cinder concrete. These boxes were manufactured in large quantities by the department and to their use is due largely the low cost of curb installations. While the box is 19 inches deep, experiments conducted by the department have demonstrated that there is no danger of freezing in this climate from such comparatively shallow settings.

The city of Wilmington is to be congratulated in having achieved the enviable and dignified position among muncipalities of being 100 per cent. metered. The benefits of this system are not yet evident to the consumer, but will at once become so with the revision of the present schedule of water rates.

The work of installing meters also disclosed an enormous amount of service complications and bad plumbing. A system of notices by letter, as well as frequent inspections, has resulted in correcting such conditions. The value of this work in reducing the consumption, aside from the installation of meters, is difficult to estimate.

High-Pressure Fire Service in Boston

For some years Boston has been working on a system of high pressure fire mains and now has some 6½ miles installed. The plans call for over 14 miles of such mains and a large pumping station on the Charles river, all of which would cost about $1,500,000. The city has secured nearly all the reductions in insurance rates which the entire system would justify and its available funds are small. It is proposed, therefore, to install a small gasoline pumping station, capable of supplying about 6,500 gallons a minute at 240 pounds delivery pressure, to the present high pressure mains. This plant would be located on the Charles river close to the Cambridge bridge and would cost but a small fraction of the above estimate. With fire-boats and the fire department's engines to help supply the high pressure mains in emergencies, the heavy expenditure provided for in the original plans is not considered necessary and the installation of the small plant is recommended by Joseph A. Rourke, engineer in chief of the high pressure service.

Method of Raising Money for Public Improvements

A method of anticipating revenues in order to secure the benefits of earlier construction of needed public improvements has been practiced in New Orleans. It seems that the New Orleans Sewerage and Water Board and the Orleans Levee Board have more calls for new construction than they have present funds to meet, but they have annual revenues which can be used to pay off debts incurred for improvements.

In one case a land company wanting a levee loaned the Levee Board the money needed to build it without interest with an agreement that the money be repaid in installments within five years. In another case the property owners did the same thing on a certificate plan whereby they borrowed the money from a bank at 2 per cent. discount and obligated themselves to pay 6 per cent. interest the first year, each on his share of the loan, and 5 per cent. for the following five years, when the loan became extinguished by the payments from the Levee Board. The property owners gained much more than the interest they paid, thru the early and rapid development of the district on account of the improvement.

The Sewerage and Water Board, in similar straits for ready money, is proposing the same plan to those wishing water and sewer mains in advance of sufficient settlement to produce a revenue giving proper return on the investment. The property owners thus carry the cost over the period of development, and on account of the more rapid development of the improved property, they gain much more than they have expended.

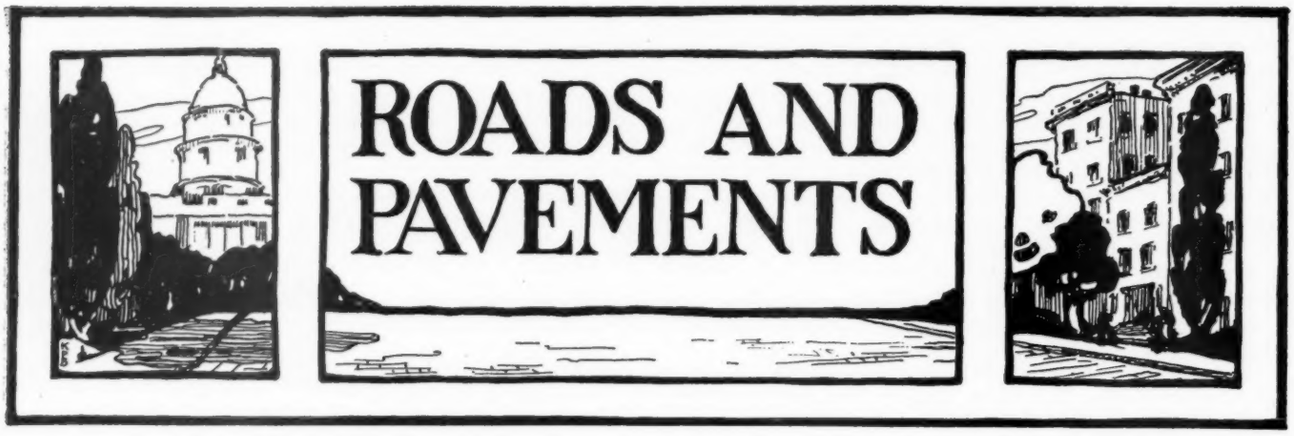
Alexandria, La., Owns Its Street Railway and Lighting Plant

Alexandria, La., has recently acquired its street railway system and is now operating it, in connection with the municipal water and lighting plant.

The plant has been completely changed and enlarged within the past four or five years, and is now considered strictly "up to the present" in every particular. Every improvement and addition to the power house and to the machinery, as well as to the water and light plant thruout the city, has been paid for out of the proceeds of the plant.

Among the improvements that have been made in the past few months is the enlargement of the main building, which is now about 60 by 100 feet. There are concrete floors in the engine room. The large turbine engine is a 1,000 kw. This machinery takes care of the city light business and furnishes power for the street railway.

Many new light lines have been constructed to new sections of the city, as well as water main extensions. The power plant is taking care of the city's newly acquired street railway system without the addition of a great amount of machinery. This part of the business is being operated at a much smaller cost than it was formerly by the independent street car company.



Resurfacing Old Concrete With a New Concrete Wearing Surface

From advance sheets of report by Edward N. Hines, Chairman of Wayne County Highway Commission, Detroit, Mich.

We have a large and constantly growing mileage of concrete roads and we regard the present as the opportune time to determine the feasibility of resurfacing an old concrete road with a thin layer of new concrete. Had any other section of the country undertaken such an experiment we would have been content to watch the result. However, we hope to put ourselves in a position to successfully carry on a resurfacing job should the need arise, and with this object in view we have resurfaced a section of concrete road, built in 1910, with a 3-inch surface of new concrete. Grand River Road was selected for this experiment, because we felt that it would receive the severest kind of test, on account of the heavy mixed traffic which uses this highway, and because the section selected was rough and uneven.

This section of road was built by the Owosso Construction Company, of Owosso, in 1910, and is of a two-course construction. It is 6½ inches thick, 16 feet wide, built on a crowned sub-grade. The bottom course is a 1:2½:5 mix, using crushed limestone for the coarse aggregate, 4 inches thick. The wearing course is a 1:2:3 mix, 2½ inches thick, using crushed field stone, ranging in size from ¼ to 2½ inches, for the coarse aggregate. It was put down in 25-foot sections, with ¼-inch tar paper strips cutting entirely through the concrete. The surface was struck off with a template, and somewhat irregular in finish, as we were not as careful and as thoro at that time with regard to finishing as we are at present. The edges of the road were rounded off with about a 3-inch radius (a practice which we have since abandoned). During the week of August 17, 1912, 7,444 vehicles passed a given point on this road; and during the week of September 18, 1912, 7,580 vehicles, by actual count, passed the same point, which is near where we resurfaced the road; 40 per cent. plus of these vehicles were horse-drawn, the balance being motor-driven. This territory has been built up rapidly since the above traffic count was taken, and an actual count at the present time would undoubtedly show a very material increase in the number of vehicles passing a given point. To better accommodate this increased traffic, we decided to widen the road to 20 feet. In order to do this, we broke off the rounded edge and added concrete on each side of the old road, to bring it out to the required width. A 1:2:4 mix, 6 inches deep, of washed and screened pebbles and washed and screened sand, of the same quality as our standard specifications, was used.

All the tarvia surfacing and filling, used to cover the cracks, was removed. The cracks and holes were then filled with concrete to make an even surface 20 feet wide. The expansion joints—as steel protection plates were not used—were mostly worn down. Where the joint was spalled to a considerable extent the old concrete was broken away sufficiently to give a bond for new concrete on both sides of the joint. Expansion felt was then placed and the whole surface brought up to an even grade. On the top layer of this base we placed a 3-inch layer of 1:1½:2½ concrete, using Marquette, Mich., trap rock, graded in size from ¼ to 1 inch for the coarse aggregate and washed and screened bank sand for the fine aggregate. The surface in no place is less than 3 inches thick, reinforced with No. 26 triangular mesh wire. We did not try to bond the top course to the old road with a rigid bond. The surface of the old concrete was first sprinkled with water, after which a mixture of tarvia A and tarvia X was sprinkled on, hot, with an ordinary sprinkling can, immediately before placing the new wearing surface. The tarvia, falling on the moist concrete, spread in a very thin layer and was immediately chilled, thus forming an even coat over the old surface. The expansion joints in this top course coincide exactly with the expansion joints in the bottom course. A piece of wood, 3 in. by 4 in. by 20 ft. long, was laid over the old joint, and the concrete deposited as tho no joint was to be made. A Baker automatic finishing machine was used to finish the surface. Afterward this piece of wood was removed and armor plates, suspended from installing bars, with expansion felt, were set into place on the side forms, the felt of the new joint meeting the tar paper of the base joint. We believe this method to be better than pouring the top course directly onto the bottom one, as a slight movement, due to difference of expansion or heaving, would result in cracks to the top course, if they were rigidly bonded together. The tarvia, although very thinly spread, permits a slight movement of each course without interfering with the other.

Before approving of this type of construction small slabs of concrete were made, a coat of tarvia put on top and another course of concrete deposited. It was found not only impossible to separate these two layers, but a blow on the upper, sufficient to crack the top course, would also crack the bottom one. The road was covered in the regulation manner, to hold the moisture, and sprinkled daily for two weeks. Traffic was permitted to use the road twenty-five days after the last concrete was placed.

The cost of this work, $15,573.67, is high, due to conditions at time work was undertaken, and should not be regarded as a factor in this particular instance, as it is the determining of a principle that was being undertaken. If the principle is correct, the working methods can be perfected to bring the cost down where it belongs.

This section of road has been in use about four months and to date is apparently successful. A much longer period of time must elapse before we can make a positive statement as to its success.

While the road was closed during the construction of this experimental section, we provided a good detour which took traffic only a short distance out of its regular course, and it

was necessary to use considerable quantities of crushed stone to put the detour in a fair condition.

We believe it wise to add a word of caution that this resurfacing is regarded by us as wholly in the nature of an experiment which should be watched and studied, rather than generally advocated, until it has proven itself out.

Road Improvement in West Virginia

Of the $33,000,000 of road improvement funds provided in the southern Appalachian states, in the 10 preceding years, 38 per cent. has been produced in West Virginia in the past 3 years, and 23 per cent. has been provided for in the past 12 months in West Virginia. This is a great showing for the new State Road Department. There being now $12,968,500 authorized bonds of which $12,088,500 has been voted since the department was organized.

The county court of Taylor has called for a vote on a $100,000 bond issue in Knottsville district, November 7, and on the same date the voters of Lewis county will pass upon a bond issue of $1,000,000.

The county of Preston has recently entered an order authorizing the beginning of work in Portland district under $280,000 bond issue voted December 7, 1915, which has been by a recent decision of the supreme court released for operation.

Demonstration of Monolithic Brick Pavement Construction

Following the annual meeting of the National Paving Brick Manufacturers Association at Terre Haute, Ind., on October 5, the organization, together with thirty-five or more engineers, street and highway officials and others, invited guests, inspected the monolithic brick road built last year

ALLEN J. PARRISH, CONTRACTOR, AND W. T. BLACKBURN, ENGINEER OF EDGAR COUNTY, ILL., WHO DEVELOPED THE MONOLITHIC PROCESS.

near Paris, Ill., and watched the process of building a similar pavement on a road under contract just outside of Paris, by A. J. Parrish, of Paris.

The method of construction of the road was detailed last month in MUNICIPAL ENGINEERING in an article on the construction of brick pavements, which need not be repeated here. The photographs show the engineer who designed the road, W. T. Blackburn, or Paris; the contractor who is building it, A. J. Parrish, of Paris, who is standing on the rolled brick surface which is being grouted in the background; and the party in automobiles supplied by the public spirited citizens of Paris, traveling over the first monolithic brick highway pavement constructed.

A COMPLETED MONOLITHIC BRICK HIGHWAY.

Mr. Parrish laid 800 square yards of pavement during the day, notwithstanding the interference of the crowd of visitors with the work. Organizations, efficient supervision and co-operation of workmen were clearly visible and resulted in first-class construction.

Before going to Paris some Terre Haute streets were inspected, including the historic South Sixth street, probably the oldest existing cement-filled brick street, and still in excellent condition in the areas between intersecting streets after some 25 years of heavy use with only incidental repairs.

Brick Paving on the Lincoln Highway in Crawford County, Ohio

Eight and three-quarters miles of the total of 22 on the Lincoln Highway thru Crawford county, Ohio, have already been paved with brick and an additional mile and three-quarters are under construction as this is written. The balance of the county's Lincoln Highway mileage, 11½ miles, is surfaced with waterbound macadam in various stages of wear.

The highway passes thru the progressive machinery-manufacturing cities of Bucyrus and Galion, within the corporate limits of which lie approximately 3½ miles of the brick paving. Of the balance, 2 miles lie to the west of Bucyrus and a mile and three-quarters now under construction to the east. On the east and west of Galion are 2 miles and 1¼ miles respectively. Petitions from property owners have already been filed with the county commissioners for an additional 2 miles of brick to extend that now laid west of Bucyrus.

The portion west of Galion was built in 1914. That east of Galion and west of Bucyrus, late in 1915. Outside of city

LINCOLN HIGHWAY, WEST OF BUCYRUS, OHIO.

limits the construction is in accordance with the specifications of the State Highway Department.

The sections already built follow this design:

Width of brick pavement, 14 feet. Concrete edging integral with the base, 8 inches on each side. Total width of pavement, 15 feet 4 inches.

Depth of brick, 4 inches.

The base, 4 inches of concrete, crushed limestone coarse aggregate.

The cushion, 2 inches of sand.

The filler, cement grout, 1 to 1 mixture.

The mile and three-quarters east of Bucyrus now under construction is being built by the monolithic method whereby the brick are laid in the green concrete foundation. Following is a detailed description:

The base, 4 inches concrete, crushed limestone coarse aggregate, 1½ to 2 inches maximum size.

Width of brick pavement, 16 feet, no edging.

Depth of brick, 4 inches.

The filler, cement grout, 1 to 1 mixture.

The base is struck off to the required depth by a double template drawn forward by the mixer upon the steel side forms. Green mortar is then brought to the surface by means of a slap board. This method is different from that specified

LINCOLN HIGHWAY, NEAR BUCYRUS, OHIO.

by the National Paving Brick Manufacturers' Association. This Association has recommended the use of a double template which spreads over the surface of the green concrete base a thin film of premixed sand and cement at the same time that it strikes off the concrete.

Brick-laying follows immediately from boards laid upon the brick surface already placed. The surface is then immediately smoothed with a hand roller weighing about 350 pounds.

Grouting is delayed until the end of each working period.

Work on the pavement is progressing on an average of 200 linear feet each working day.

We are indebted to Maurice B. Greenough, instructor in highway engineering, Case School of Applied Science, and consulting engineer for the National Paving Brick Manufacturers' Association, Cleveland, Ohio, for the data and photographs regarding this road.

New York State Roads

The report of the New York State Commissioner of Highways gives many interesting facts concerning highway construction and maintenance, from which the following are selected:

Of the 1,073.2 miles of road for which contracts were awarded in 1915, 381 miles were of water-bound macadam, which cost an average of $10,250 per mile, 16 to 26 feet wide, the pavement alone costing 64.8 cents per square yard; 347 miles were of bituminous macadam, penetration method, averaging $12,970 a mile, 16 to 26 feet wide, the cost of pavement only being 87.1 cents per square yard; 176 miles were of water-bound macadam, surface treatment; 113 miles were of cement concrete, averaging $15,320 per mile, 16 to 26 feet wide, the cost of pavement only being $1.121 per square yard, 6 inches thick; 31 miles were of brick, averaging $25,750 per mile, 16 to 26 feet wide, the cost of pavement only on 5-inch concrete foundation being $2.015 per square yard; 2.2 miles were of bituminous macadam, mixed method, cost included in bituminous macadam above; 23 miles were of other types not classified. The details of cost are for pavements 6 inches thick, except that the brick pavement is 9 inches thick.

The length of road completed during the year was 1,083.35 miles.

The cost of water-bound macadam in the nine districts of the state varied from $8,189 to $12,400 per mile, 16 to 26 feet wide; that of bituminous macadam, penetration method, from $8,718 to $11,600; that of bituminous macadam, mixing method, from $16,600 to $18,700, with extra width in villages not counted; concrete, part of which is Hassam, $10,700 to $18,800; brick, from $21,500 to $47,269, not counting extra width in cities; asphalt block, $22,300 to $68,782; stone block, $34,300 to $38,500; bitulithic, $13,972, not including extra width in cities. Heavy excavation and concrete retaining walls account for the upper cost figures when they seem excessive.

The Spot Test in St. Paul

During the first half of the last month the Commissioners of St. Paul, Minn., have been occupied with a discussion of the spot test for determining adulterations for treating paving blocks and has retained the test, which was originally adopted a year or two ago, in an attempt to prevent the bleeding of blocks with which the city has been afflicted.

This test for determining the purity of an oil was devised several years ago and consists in dropping six drops of the oil on clean white blotting paper. If the oil is pure the paper will be stained a color and tint characteristic of the oil tested. If the oil contains impurities they will gather about the center of the spot and will show clearly.

The spot test, according to the investigations of the Forest Products Laboratory at Madison, Wis., will detect in creosote oil percentages of lampblack, representing free carbon, as low as 0.005 per cent. If the impurity is greater than 0.5 per cent. the amount of impurity cannot be judged, the center of the spot being too black to differentiate, but for smaller proportions it can be judged by the appearance with a fair degree of accuracy.

The same test has been adopted by European Diesel Engine users to determine the adulteration with raw tar of the heavier oils distilled from tar, which they use as engine fuel, the carbon resulting from the combustion of tar in the cylinders being very objectionable and injurious.

A coking test was presented as a possible substitute for the spot test in the St. Paul specifications, but Profs. E. E. Nicholson and I. H. Derby of the department of chemistry in the University of Minnesota showed that the proposed test could not determine the amount of tar in the mixture within the desired percentage of variation, and it was shown that the dilution of the creosote oil with tar must be accompanied with a corresponding dilution with light oils to keep the resulting mixture within the requirements of the specifications, so that the actual percentage of tar, as compared with that of creosote was not to be determined by the coking test. The spot test was therefore retained by a vote of 5 to 2, Mayor Irvin voting with the majority.

Street Paving in Texas

L. W. Kemp, editor of *Texaco Tips*, published weekly by the paving and roads division of The Texas Company for the benefit of contractors in Texas, has made a compilation of the reports of pavements laid in Texas cities in 1916, which shows the following facts:

PAVEMENTS LAID IN 1916.

Class of Paving.	Square Yards.	Miles.
Asphaltic Concrete	352,611.53	19.736
Bitulithic	337,413.18	17.082
Vertical Fiber Brick	293,527.85	15.060
Creosoted Wood Block	211,564.20	8.838
Asphalt Macadam	148,433.80	6.666
Uvalde Rock Asphalt	107,649.73	6.188
One Course Plain Concrete	90,182.20	4.914
Two Course Reinforced Concrete	87,556.50	4.643
Oklahoma Rock Asphalt	76,334.60	3.844
Granitoid	54,639.10	3.000
Two Course Plain Concrete	45,315.00	1.832
One Course Reinforced Concrete	22,829.00	1.031
Standard Brick Blocks	24,353.00	1.089
Vibrolithic	8,206.00	.441
Sheet Asphalt	5,986.00	.117
Westrumite	4,718.43	.430
Granited Concrete	1,336.20	.059
Total	1,872,656.32	94.970

ARRANGED ACCORDING TO CITIES.

1	San Antonio	703,365.96	37.149
2	Dallas	155,782.92	8.710
3	Temple	125,440.53	7.200
4	Fort Worth	79,285.00	3.655
5	Mineral Wells	74,458.00	3.584
6	Paris	62,876.41	3.900
7	Houston	61,437.88	2.733
8	Sulphur Springs	60,072.47	3.030
9	Galveston	40,232.15	1.929
10	Waco	39,288.77	1.610
11	El Paso	38,437.00	1.640
12	Arlington	37,391.00	1.350
13	McKinney	36,325.00	2.834
13	McKinney	36,325.00	2.834
14	Yoakum	36,297.00	1.570
15	CORSICANA	34,484.40	1.220
16	Denison	33,651.00	1.350
17	Corpus Christi	32,953.63	1.470
18	Ennis	27,965.00	.830
19	Wichita Falls	27,544.80	1,213
20	Terrell	27,000.00	1.487
21	Marshall	22,616.60	1,260
22	Austin	19,025.80	.922
23	Abilene	15,860.80	.720
24	Lufkin	14,044.00	.750
25	Mt. Pleasant	13,480.00	.520
26	Vernon	12,562.00	.400
27	Bryan	11,231.00	.304
28	Hillsboro	9,155.00	.590
29	Sweetwater	7,956.00	.280
30	Greenville	7,220.20	.600
31	San Angelo	2,028.00	.....
32	Texarkana	1,689.00	.070
33	Highland Park	1,499.00	.090
	Total	1,872,656.32	94.970

Seattle Municipal Asphalt Plant

Until August, 1912, Seattle, Wash., let its asphalt street repairing to the contractors laying the streets at an average price of about 3 cents per square yard per year. If the city had continued the contract policy it would have paid the contractors for such repairs $109,511.40 in the 3½ years or so since the city took the repair contracts over. During 1914-5 the operation of the asphalt plant cost $6,969.89 more than was received from work done for other parties, showing a saving of $102,541.51. This saving would take care of much of the cost of the plant as well as of depreciation and interest charges and of other overhead charges if the $1,500 included in the figures of cost is not considered sufficient.

Maintenance by the department is reported to have cost 0.283 cent a square yard a year as compared with the former contract prices of 2.8 to 3.5 cents per square yard per year. The average cost per square yard of repairs actually made was $1.56 a square yard in 1915.

Good Roads Notes

The latest report of the State Road Commissioner of New Jersey states that the cost of the roads which it was intended to build with the $7,000,000 bond issue authorized by the legislature will be more than doubled on account of the higher cost of labor and materials, due to the return of laborers to European countries to go into the war and the high prices paid for labor in munitions factories. The latest estimates bring the probable cost of these roads up to $15,000,000.

The Illinois State Highway Commission has awarded to Walter H. Lienesch, chief engineer, Universal Concrete Products Co., 208 South LaSalle street, Chicago, Ill., the prize which it offered for the best design for a road sign to be used on state-aid roads. The concrete sign-board with inlaid concrete letters is removable from the concrete post with a galvanized pipe cast in it, a concrete cap on top covering a metal nut which screws on the upper end of this pipe to hold the sign in place.

According to the U. S. Office of Public Roads expenditures for road and bridge work in the U. S. have increased from $80,000,000 in 1904 to $282,000,000 in 1915. State expenditures increased from $2,550,000 to $53,000,000.

The first concrete street pavements, 9,000 square yards, to be built in Maine, were started a few days ago at Norway, Oxford county.

Since January 1, 1916, the Maryland State Highway Department has let contracts for nearly 60 miles of concrete road. Indications are that a total of 80 miles will be reached before the end of this year.

Three and three-fourths miles of concrete has been finished and opened to traffic on the Princess-Anne road, Norfolk county, Va. This is the first important stretch of concrete road in the state.

The National Highways Association and the Meridian Road Association have published a map of the Meridian road, which runs from Pembina, N. D., at the Canadian line, almost on a meridian line to Galveston, Tex., with a branch from Waco to Laredo on the Mexican line. There are but few cities of very considerable importance upon the line.

Hillside wire-cut-lug brick will be used on 650 feet of a hill on the Elmira-North Elmira, N. Y., state highway, contract for which has been let to P. F. Connelly, of Horseheads, N. Y., the width to be 39 feet. Part of the 4¼ miles of the contract will be of brick on concrete foundation, 30 feet wide, except on the hill, part of bituminous macadam, 16 feet wide, and part of water-bound macadam, 14 feet wide.

Clay county, Missouri, has voted $1,250,000, being about $6,500 a mile for some 200 miles of good roads construction, which, if judiciously expended, will furnish the hard surfaces necessary on the main lines and excellent surfaces for the less traveled roads.

The board of supervisors of Forrest county, Miss., have set the prisoners in the county jail to work on the county roads to repair the serious damage done to roads and bridges in the southern part of the county by the hurricane of July 5 and 6. The other work in the county, partly due to the storm, was provided for the first week in July.

The Good Roads Year Book of the American Highway Association has been issued for 1916 and sustains the high reputation gained by previous issues in keeping up to date the information about road laws, road systems, financing of road construction and maintenance, names of producers of road materials and machinery, etc. The book is sold at $1 or five copies for $4. Fairfax Harrison, president of the Southern Railway Company, is president of the association, whose offices are in the Colorado building, Washington, D. C.

Proceedings of the thirteenth annual convention of the American Road Builders' Association, containing all the information about the organization, as well as the valuable papers presented at the convention. E. L. Powers, secretary, New York.

MISCELLANEOUS

Meetings of Associations

Nov. 20-25 at Springfield, Mass., 10 conventions will be held as follows: National Municipal League, 23-25; City Managers' Association, 21-23; Civic Secretaries' Conference, 23, 24; Conference on Municipal Research, 22, 23; Training School for Public Service, 22, 23; Intercollegiate Division of National Municipal League, 22, 23; Massachusetts Federation of Planning Boards, 23, 24; Western New England Chamber of Commerce, 22; Massachusetts Civic League, 21; and Massachusetts Single Tax League. Most of these associations join with the first named in one cession or more. A graphic chart of the conventions has been prepared by the Springfield Bureau of Municipal Research and will be sent on request.

Feb. 5, 1917 in Mechanics building, Boston, Mass., American Road Builders' Association.

Feb. 7-15, 1917, at the Coliseum, Chicago, Ill. The 10th Chicago Cement Show. Cement Products Exhibition Co., Chicago, Ill.

Feb. 8-10, 1917, at Hotel La Salle, Chicago, Ill. The American Concrete Institute.

Feb. 11, 12, at Hotel Sherman, Chicago, Ill. National Builders Supply Association.

Feb. 13, 14, at Hotel Sherman, Chicago, Ill. Illinois Lumber and Builders Supply Dealers Association.

The Newark Convention of the American Society of Municipal Improvements

The convention of the American Society of Municipal Improvements at Newark, New Jersey, October 10 to 13, was so interesting that it was proof against the counter attractions of New York and the many attractions offered the members by the generosity of the local committee and their friends, who gave individuals and small parties every opportunity to investigate the objects of municipal and engineering interest in this interesting region.

The program was followed closely, with two exceptions, and was thruout of absorbing interest as judged from the large attendance at the sessions. On Wednesday afternoon was scheduled the discussion of sewage treatment, represented on the program in papers and written discussions of the papers by nearly all the experts engaged in developing the process. There was also a paper on the latest experience with the Imhoff tank. Nearly all the discussion had been arranged for beforehand by George A. Carpenter, the chairman of the committee having the meeting in charge, and all the papers but one were printed and in the hands of members. Two papers were carried over from the morning session on account of the use of stereopticon and all the papers on the sewage disposal program were presented in abstract or in full. The deprivation came from the stopping of the discussion because of an eleventh hour notice that the room must be vacated to prepare for the evening. This cut an hour and a half off the scheduled length of the session and prevented the asking of questions on points on which minor detail was desired. Groups of those specially interested got together and continued the discussions but the audience as a whole missed the interest of question and answer, tho the advance papers contain practically all the information which could be brought out.

The association has a custom of devoting but two sessions to entertainment and excursion features, but Newark had so much to offer of the latter class that the discussion of paving problems, set for Thursday, was crowded. It was supposed that the discussions of paving specifications would be worked out in committees, as usual, but the probability of discussion on the convention floor developed in the committee meetings and the report of the committee on standard specifications was set forward. The discussions occurred and were extremely interesting to all the large audience present. But the result, as usual, was that the recommendations of the general committee were adopted without modification. This relegated the evening papers on paving subjects to the list read by title. It is doubtful, however, if any of those present at the evening discussions on specifications or on the excursion, which occupied half the morning and all the afternoon, would have voted for the elimination of the excursion or the cutting off of the discussions.

At the meeting of the executive board on Tuesday morning before the convention opened, a committee was appointed to consider changes in the constitution as to treatment of questions regarding changes in specifications on the floor of the convention and as to classification of members. On Friday morning the association provided for such a committee to report far enough in advance of the next convention to transmit its report to the members with the volume of advance papers.

An increase of 25 per cent. in membership during the year and applications from about 140 more at the convention, including delegates from municipal members, showed the growing interest in the society and the increasing appreciation of its earnest and efficient work during its long life of usefulness.

The first vice-president, Norman S. Sprague, of Pittsburgh, Pa., was elected president, E. R. Conant of Savannah, Ga., G. H. Norton of Buffalo, N. Y., and R. K. Compton of Baltimore, Md., were elected first, second and third vice-presidents, Charles C. Brown was continued as secretary, F. J. Cellarius of Dayton, O., was elected treasurer, and George A. Carpenter of Pawtucket, R. I., F. A. Reimer of East Orange, N. J., and Hal Moseley of Dallas, Tex., were elected on the finance committee.

New Orleans was selected as the next place of meeting, with City Engineer W. J. Hardee in charge of the local arrangements. The meeting will be held in the middle of November, 1917.

Fellowship Established for Asphaltic Research

With the co-operation of Harvard University and the Massachusetts Institute of Technology, The Barber Asphalt Paving Company has established at these institutions a fellowship for research in asphaltic materials and their uses. The fellowship is to be known as "The Clifford Richardson Fellowship." Mr. Richardson is a distinguished alumnus of Harvard and this, taken in connection with his great contributions to asphaltic highway construction and his work in the chemistry of bitumens, makes the designation of the fellowship particularly appropriate. The appointment of the incumbent of the fellowship and the choice of subjects for investigation, as well as the disposition to be made of the results of such investigations as may be undertaken, are to be decided by the institute faculty or the joint committees of the university and the institute having control of engineering work.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Nov. 8: Junior drainage engineer in Office of Public Roads at $960 to $1,440; copyist draftsman in Navy Department at Washington, D. C., at $2 to $3.44 a day; assistant inspector of hull material at any navy yard, at $4.48 a day.

Nov. 8-9: Laboratory assistant qualified in petrography in Bureau of Standards at Pittsburg, Pa., at $1,080 a year.

Nov. 14: Expert electrical and mechanical aid in Bureau of Yards and Docks, Washington, D. C., at $12.48 a day; general mechanic in Indian Service at Sac and Fox Sanitarium, Iowa, at $720 a year.

Nov. 21: Assistant petroleum engineer in Bureau of Mines, in the field, at $1,800 to $2,500 a year; expert aeronautical aid in Department of Construction and Repair, navy yard, Washington, D. C., at $13 a day; designing mechanical engineer under Board of Engineers, U. S. Army, New York city, at $2,100 a year; petroleum technologist in Bureau of Mines, in the field, at $2,500 to $3,000 a year; radio draftsman in Navy Department, Washington, D. C., at $3.04 to $6 a day.

Nov. 22: Laboratory assistant in ceramics in Bureau of Standards, Pittsburg, Pa., at $900 to $1,200 a year; observer and meteorologist in Weather Bureau, at $1,260 to $1,620 for observer and $1,440 to $1,800 for meteorologist.

Nov. 22; 23: Assistant engineer at $1,500 up and junior engineer at $900 up, in Reclamation Service; clerk draftsman in General Land Office Service, at $1,200 a year.

Technical Schools

The School of Commerce and Administration of the University of Chicago has issued its announcements of courses of training for business, commercial teaching and secretarial work for 1916-17. Leon Carroll Marshall, dean.

The Bureau of Municipal Research, 261 Broadway, New York, in its Training School for Public Service, offers courses in municipal highway enginering and in engineering administration, the first for a half year once a week beginning November 14, and the second for the last half of the school year, ending in May, 1917. The lectures will be given by Prof. A. H. Blanchard at the Automobile Club of America, 247 West 54th street, New York, at 8 p. m., the fee for 15 lectures being $10.

The dedication of the new Ceramic Enginering building of the University of Illinois, Urbana, has been postponed to December 6 and 7, 1916.

Municipal Notes

Silvam Springs, Ark., has completed its sewer system at a cost of $50,000. It includes 10.6 miles of pipe sewers and a sewage disposal plant capable of treating 300,000 gallons a day.

Municipal Reports

The first annual report of the city council of Beaufort, S. C., under the commission manager plan of city government, for the year ending May 1, 1916, has been issued. It shows a change from deficits to surpluses in city funds and the turnover of about $30,000 a year in general city and water departments together. H. G. Otis is city manager; H. R. Pollitzer is city engineer and superintendent of public work.

The ninth annual report of the Pasadena, Cal., municipal lighting works department, for 1915-6 has been issued. C. W. Koiner, general manager and electrical engineer.

The forty-seventh annual report of the West Chicago park commissioners is a handsomely illustrated volume of 211 pp. A. C. Schrader, superintendent and engineer.

Good Roads of Monroe Co.. New York, 1915, is the title of the report for 1915 of J. Y. McClintock, county superintendent of highways, Rochester, N. Y.

Annual report of County Engineer of Essex County, N. J. F. A. Reimer, county engineer, East Orange. N. J.

Report for 1915 of water commissioners of Danvers, Mass., Henry Newhall, superintendent.

First Report of the Municipal Recreation Committee of South Bend, Ind., F. B. Barnes, director.

Report for 1915 of water board of Auburn, N. Y., J. Walter Ackerman, chief engineer and superintendent. A pitometer and electrolysis survey of the distribution system were made and the books were audited by a certified public accountant.

Report for 1915 of the board of health of Concord, Mass., John M. Keyes, chairman.

Report for 1915 of road commissioners of Concord, Mass., John M. Keyes, commissioner of roads and bridges.

Report for 1915 of Board of Public Works and Water Commissioners of Little Falls, N. Y., Geo. I. Oakley, city engineer.

Report of the Board of Engineers on Sewage Disposal for Pasadena, South Pasadena and Alhambra, Cal., including form of contract between the municipalities. R. V. Orbison, city engineer of Pasadena, chairman.

Personal Notes

Robert H. Boynton, city engineer of Frankfort, Ind., died on September 18. He was a promising young engineer, a graduate of the University of Michigan in 1910.

William H. Reid, smoke inspector of Chicago, has been elected president of the National Smoke Prevention Association.

Publications Received

Standards for Electric Service is the title of Circular No. 56 of the U. S. Bureau of Standards, Washington, D. C., giving rules and recommendations for the regulation of electric service companies by State Commissions; three ordinances for such independent regulations by towns and small cities, cities generally, and large cities having electrical inspectors; also specifications for approval of types of electric meters by commissions.

Bulletin 89 of the Engineering Experiment Station, University of Illinois, Urbana, is on specific gravity studies of Illinois coals and is by M. L. Nebel.

Industrial Conditions in Springfield, Ill., by Louise C. Odencrantz and Zenas L. Potter, is the latest to be issued of the 10 parts of the report of the Springfield survey. It occupies 155 pp., has 20 illustrations and costs 25 cents. The series as a whole shows the methods and results of a thoro city survey of a typical city of moderate size and can be obtained either singly in paper or bound in 3 cloth volumes.

A professional paper on "The Flow of Water in Wood-Stave Pipe," by Fred C. Scobey, irrigation engineer, is published in Bulletin 376 of the U. S. Department of Agriculture.

MACHINERY AND SUPPLIES

The Double-Quick Backfiller

A trench backfiller devised and sold by the Waterloo Cement Machinery Corporation, Waterloo, Iowa, consists of a hoisting engine mounted on a wheeled truck with a revolving turntable, so that it can operate in almost any direction. When working on a trench its range is about 90 degrees at each setting of the machine.

A plain slip or drag scraper is used, drawn by a rope operated by the hoisting engine. The scraper is drawn back by a man for each draft of earth it makes. The earth can be handled exactly as desired.

The machine is moved forward by a block attached to a peg driven in the ground, attached at one end to the tongue of the truck and running at the other around the winch head of the hoisting engine, which has been turned to set squarely on the truck for this purpose.

Two men operate the machine the same as with a team, but can do twice as much work in the same time. The power is a 7-h.p. horizontal hopper-cooled Wonder gasoline engine.

The machine is available just as readily for lowering pipe into a trench, loading and unloading, snatching teams, pulling cables, pulling piles or cribbing, hoisting, hauling overground and any similar pulling or hoisting work.

Unique Truck Camera

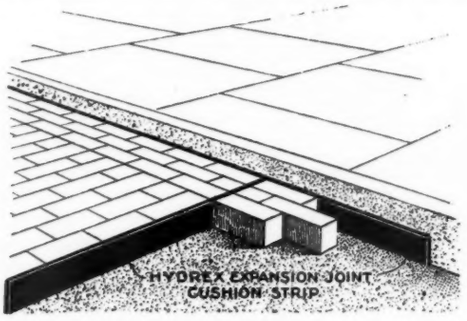
The most interesting newspaper innovation in the way of setting live-up-to-the-minute pictures before eyes of the reader goes to the credit of the Philadelphia Public Ledger. The Ledger has a photograph auto patrol equipped with high power cameras, especially designed for fast work. This patrol answers fire alarms, emergency calls of all kinds—anything that offers the possibility of real news pictures. And the rapidity with which the patrol travels and works makes newspaper pictures available that could not be thought of under the old conditions. The truck as illustrated is equipped with Goodrich tires.

CAMERA PATROL OF THE PHILADELPHIA PUBLIC LEDGER.

Hydrex Expansion Joint Strip

The accompanying illustration shows the adaptation of Hydrex expansion joint cushion strip for longitudinal and transverse purposes.

This type of prepared joint, which is manufactured by The Hydrex Felt & Engineering Co., consists of a special



bitumen compound of great ductility and flexibility, which is made up into strips five feet long and of any width or thickness desired.

flexibility and cushion-like effect under varying degrees of temperature, being especially designed and used to meet these conditions.

Jeffery Fire Trucks Popular

The following cities are using Jeffery motor trucks, either as fire trucks or in the police service: Lebanon, N. H.; Chippewa Falls, Wis.; Whitewater, Wis.; Collinsville, Wis.; Kenosha, Wis.; Reading, Penn.; South Bend, Ind.; Waukegan, Ill.; Oakland, Cal.; Whittier, Cal.; Minneapolis, Minn.; Long Beach, Cal.; Boston, Mass.; Pomona, Cal.

New Concrete Mixer Accelerates Hawaiian Road Work

A new concrete mixer which arrived at Hilo, Hawaii, by the steamer Enterprise, was utilized by the road department, having been requisitioned by road overseer Lyman for the concreting of Front street.

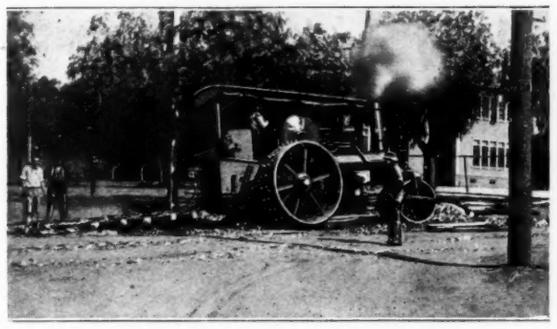
This mixer immediately demonstrated itself to be a great improvement over the old equipment, the progress of the work of laying concrete on Front street will be considerably accelerated, so much so, in fact, that the work was finished many days earlier than expected.

The mixer is a Chain Belt mixer and was obtained by the county from the A. L. Young Machinery Company of San Francisco thru the Honolulu Iron Works. It has a capacity for mixing 14 cubic feet of concrete and distributing the mixture just where it is required, thus saving a great deal of unnecessary labor. At the beginning the mixer could not be operated to its full capacity, due to the fact that the workmen were too inexperienced to take full advantage of the facilities offered. Within two weeks the county was laying from 175 to 225 linear feet of concrete road daily, the road being 20 feet wide.

Tractor Pulls Up Old R. R. Track

In Redlands, Cal., it recently was decided to improve a certain thorofare which at one time was a railroad right-of-way, but which had not been used as such for a long time. Before putting down new paving it was, of course, necessary for the city to remove the old rails and ties, and conditions at the time made it requisite that this be done as cheaply as possible and in the very shortest time.

The ties were deeply imbedded and the rails were rusted tightly to them. Hand labor in removing the car tracks implied the necessity of prying the rails loose from each tie at considerable expenditure of both time and money.



Courtesy of Popular Mechanics.

A TRACTOR IN THE CITY OF REDLANDS, CAL., BEING EMPLOYED TO PULL UP A STRETCH OF ABANDONED RAILROAD TRACK.

It was finally decided to employ an ordinary tractor, which, it was found, obviated all need of separating the rails from the ties for removal.

The procedure was simply to remove some of the earth from between the ties, after which the tractor was hitched to the car track and the signal to "Go ahead" given. The tractor was able to pull out sections about 20 ft. long with considerable rapidity and within 2 days had torn up more than a mile of track.

Motorcycle for Sewer Inspection

At Pasadena, Cal., a new 6½ mi. sewer is nearing completion. A local sanitary engineer recently was ordered to make an inspection tour through it, which implied a long, arduous walk with periodic halts for examination of certain phases of the construction. It was estimated that the trip would consume almost an entire day's time.

The engineer in question, however, accomplished the entire trip in only 2 hrs. and 15 min. via motorcycle instead of a-foot. The machine was lowered into the tunnel thru a shaft and was driven at low speed to the mouth of the underground bore. A mechanic operated the motorcycle, while the engineer occupied the auxiliary seat behind him and scrutinized the sewer walls as they slowly passed. Frequent stops were made and no difficulty whatever was experienced on the trip. The motorcycle's powerful headlight was the only illumination used, either for guiding the way over the rough sewer bottom or for examining the walls.

The Sanitary Engineer was Carried through the Sewer on a Motorcycle and Completed His Tour of Inspection in Slightly More than Two Hours.

Courtesy of Popular Mechanics.

A Tractor for Light Contract Work

Herewith is illustrated a small tractor weighing a total of 5,000 lbs., or about 5½ lb. per square inch of contact surface. Despite its diminutive size the tractor is guaranteed to develop 20-h.p. on the belt and 12-h.p. on the drawbar. The motor is a Waukesha, with four vertical cylinders, a 4½-inch

bore, 5¾-inch stroke and a speed of 800-r.p.m. The tank capacity is 20 gallons of gasoline and the steering wheels are 42 inches in diameter, carrying 8 by ⅜-inch tires. A speed of

2.7 miles per hour can be attained on high gear, and 2.1 miles on low. The machine can be turned either backward or forward within a 15-foot circumference.

The tractor, which is made by the Tom Thumb Tractor Co., of Minneapolis, Minn., is designed primarily for use by the small contractor and farmer, or for lighter work on large contracting jobs. It is specially convenient where soft spongy soil must be worked over without packing it down, as often happens with large wheel-type outfits.

The accompanying photograph shows the tractor pulling a string of loaded trailers, which themselves are particularly designed for road construction work.

A New Tunneling Machine

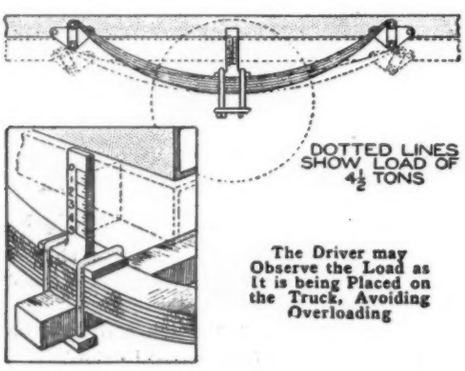
A new tunneling machine like one which soon is to begin the tube under the English Channel at Dover, England, is now operating beneath the Grand Central Railroad terminal, New York city, digging its way through solid rock.

The cost of tunneling with this machine is $13 a foot, as compared with $35 per foot under present methods. The crew consists of 3 men; the present methods require 50 men. Its rate of driving is 24 ft. a day, compared with 8 ft. under present methods.

A further feature, that it eliminates blasting, is in itself reason enough for its replacing the present method of tunnel driving.

New Load Scale for Trucks

One of the most common and, at the same time, severe abuses to which the average motor truck is subjected is overloading. To alleviate this condition Joseph Husson, of New York City, has devised a load scale consisting of two uprights, graduated and attached to the centers of the rear springs. They extend above the lower edge of the truck frame, by which the exact weight of the load is indicated on the scale. When empty, the lower edge of the truck frame should register at zero and when loaded to full capacity, it



The Driver may Observe the Load as It is being Placed on the Truck, Avoiding Overloading

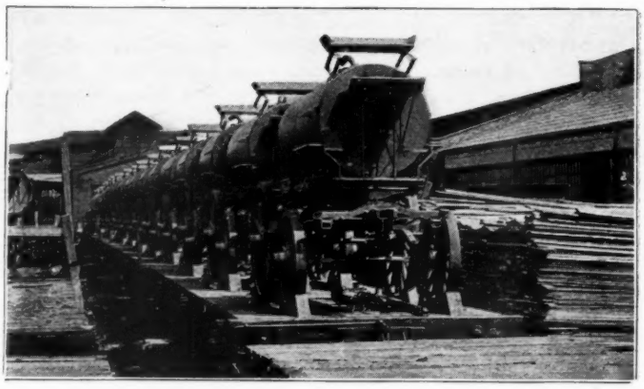
should be exactly opposite the maximum load mark, which is the highest figure on the scale.

Mr. Husson determined his scale markings by placing the truck on a level and weighting its platform evenly with successive 1-ton loads, 1½-ton loads, etc., the markings on the scales being made at the lower edge of the frame. Of course the gradations are not equally spaced, on account of the small deflection of the springs under light loads.

Sprinkling Wagons for Army Use

The photograph herewith represents part of a shipment of 40 Austin sprinkling wagons ordered by the U. S. Government. The picture shows the trainload ready to leave the Austin factory. These machines are the Austin standard 600-gallon platform-spring type with steel tanks. They were purchased by the War Department for use with the troops in the southwest.

It is very much in favor of the construction of these machines to be able to say that the U. S. Army authorities have found the Austin standard construction so good that it was capable of passing their tests and standing up to the exceptionally rough work accorded these machines on the Mexican frontier, no alteration or reinforcement of the Austin stand-



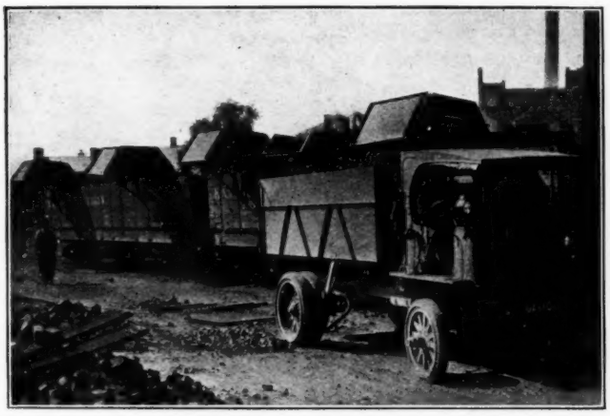
ard construction being found necessary for this specially severe work. This ought to be a sort of assurance to the users of street sprinklers for more ordinary purposes in connection with street cleaning departments where the service is not anything like so severe, and it accounts for the long life which this Austin equipment possesses.

"Lightning" Loader Skip Economy

Devices for facilitating the loading and unloading of materials certainly have come into their own since the advent of the motor truck for transport. These loaders are being particularly favored for many classes of contracting work when so constructed that they may be quickly dismantled and moved about from job to job.

The "Lightning" loader ship is of this type and the illustration shows how it can be placed in position on loaded freight cars. The Garford Motor Truck Co., Columbus, the General Motors Co., the Carnegie Steel Co. and similar large corporations are making extensive use of them in this way.

It consists of a steel pan or body with an end gate and two demountable steel side-boards, together with a pair of short-coupled rigid-steel structural brackets. It can quickly be mounted on any type of an open gondola or freight car by simply setting the loader on the brackets which attach to the side of the car. The pan or tray is dropped into position and held there by means of an adjustable pivot bar, which, with its own supporting stem, is fitted with three holes permitting the raising or lowering of the body. The loader rests in a



slightly inclined horizontal position, allowing plenty of clearance between the extreme height of the truck and the ground level. This bar is seated in a cast-steel shoe, riveted to the sides of the body.

The construction of the pan or tray is such that it can be heaped with materials and gives a maximum load to the truck every trip.

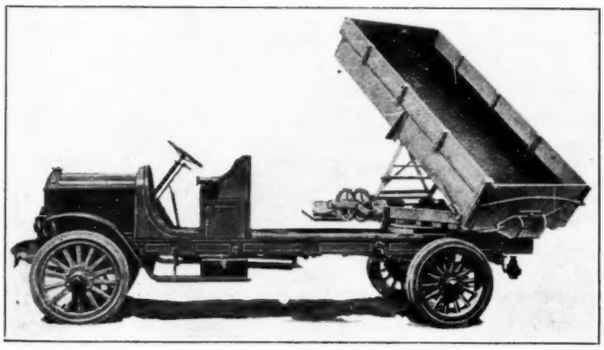
When in position on the car, the loader is prevented from dumping inopportunely by means of two steel levers which securely lock the chute. Any class of bulk materials can be handled and will receive a quick, clean discharge into the waiting truck. The fact that there are no pivot bars or other obstructions to prevent a quick movement of materials make this skip unusually satisfactory for the handling of coal and like materials.

Turn-Table Dumping Feature

The accompanying illustration is interesting in view of the fact that this Wilson truck has been specially designed for use by contractors in very narrow streets or confined quarters where it would be impossible for the vehicle to back to the curb or whatever other spot was intended for the dump. In addition to the hand-hoist feature, this body is mounted on a turn table, so that after the proper angle of elevation is obtained the body may be swung around in any direction to discharge its load.

This sort of truck is commonly known as the semi-trailer type because the forward end of a large 2-wheel trailer is supported on the turn table which is itself mounted on the motor truck chassis, and the major portion of the weight of the 3 to 5-yd. body rests on the two trailer wheels. In this type loads up to 5 tons are transported. Both hand and power-dumping devices also are noteworthy features.

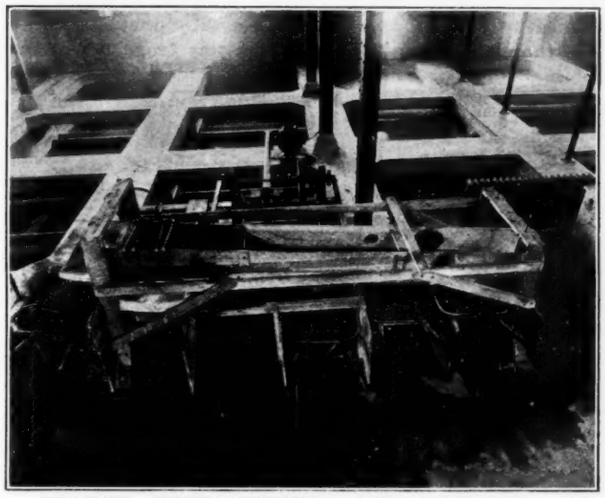
The Wilson semi-trailer outfits are designed to be fitted with any of the standard types of dumping bodies, such as the Lee, Lally, Woods, or the Watson bottom dump. Still other forms comprise variations of the well-known reach trucks for the transporting of steel, stone or timbers swung beneath the frame. For the carrying of heavy machinery, a low platform body with a minimum height of 18 in. may be had.



New Shaking Screen Grades in Six Sizes

Mr. Walter A. Sperry, chief chemist of the filtration plant of the board of public works, city of Grand Rapids, Mich., is the inventor of a simple riddling machine which lately has been doing in a single day all the work that formerly required a week to perform by hand labor.

A motor operates a shaft equipped with cams which shake a suspended trough into which the sand and gravel is emptied. The trough is set at a slight angle, causing the material to travel over some or all of the 6 screens of various sizes which constitute its bottom. In this way the gravel is speedily divided into six grades and falls into separate bins. The material thus separated is used in the filter beds. L. I. Cutcheon, general manager of the Grand Rapids board of public works, states that the machine "has proved to be economical both from point of operating cost and in time saving."



TROUGH WITH SCREENS FOR WASHING AND SCREENING GRAVEL FOR USE IN WATER FILTERS OF GRAND RAPIDS, MICH., WATER WORKS. NOTE SIX SIZES OF SCREENED GRAVEL AND SAND.

Electric Pole-Setting Derrick on Truck

The Boston, Mass., telephone company has recently lessened the labors of at least one crew of linemen by inventing a special derrick which can be either attached or detached from their service truck in about 5 min. Its construction is simple.

The chief beam is a 6 by 6-in. spruce upright, 17 ft. in length, which is fastened to the rear of the motor truck. The lower end of the beam is so notched as to fit between the tailboard and the end of the body, the beam likewise being bolted to a heavy crossbar attached to the rear uprights of the truck's cover.

All lifting is done by a block and tackle in connection with an electrically operated winch which is firmly mounted on the truck. That the derrick is entirely practical is demonstrated by its recent record in picking up four 40-ft. chestnut poles, carrying them 200 ft. and there depositing them in the proper holes, all in 25 min.

Patents Issued on Colloidal Bitumens

United States patents have just been issued to Clifford Richardson on an improved "bituminous substance" and on the process by which this product is manufactured. Similar

patents have also been granted in Canada, Great Britain, France and Italy. It is believed that these are the first patents covering a product and process involving the introduction of colloidal matter into bitumens of all types. According to the inventor he obtains "an increased degree of body or stability in these bituminous substances, by means of the addition to and intimate and uniform dispersion through the bituminous substance of a proper proportion of a substance in the state of a disperse colloid. The process consists in the introduction of clay in the form of a colloidal aqueous paste and combining this paste with the bitumen in such a way that when the water is subsequently driven off, the bitumen forms the continuous phase of the colloidal material.

The products resulting from this method of incorporating clay in colloidal form with bitumen has markedly different properties from products into which the mineral matter is introduced in the form of a dry powder. The products made by the Richardson method range all the way from materials resembling vulcanized rubber to plastic but at the same time very stable mixtures suitable for paving and many other uses.

Cheap Water Supply for Concrete Mixer on Road Construction

Mr. G. B. Brodie, of the W. M. Brodie Co., contractors, Newcomerstown, Ohio, in reviewing the accomplishments of a 3-h.p. Domestic pump, states that the cost of operation has been less than $1 per day, whereas the cost of water haulage would have totalled $15 per day.

"This outfit," states Mr. Brodie, "takes water from the river, the pump being set 12 ft. above and 40 ft. distant from the supply. Suction line is 1½-in. We have laid 3,400 ft. of 1¼-in. line and are easily forcing sufficient water thru 2,800 ft. of it to take care of a concrete mixer operating at the rate of one batch per minute, and also to furnish water for the boiler and for sprinkling the sub-grade.

"The pipe cost us on cars here $5.3475 per 100 ft., and the laying ½ cent per ft. This does not include taking it up.

"We believe the pump will furnish water for an additional 1,000 ft. and perhaps more, as we have not been operating it at over 70 per cent. capacity thus far."

This gas engine, as above described, and which is made by the Domestic Engine & Pump Co., Shippensburg, Pa., will deliver 3 times as much water as will 2 teams.

The economy is indicated from the following authentic water cost data on actual contract work of puddling 1 mile of waterbound macadam. In both instances, the average water haul was ½ mile and the work required 20 days:

WHERE THE WATER IS USED. CONCRETE MIXER IN THE DISTANCE AND WATER SUPPLY PIPE AT THE RIGHT.

1. Sprinkler Cart Used; Road No. 1184, Aug. 1914.

—Investment—

Sprinkler tank fitted with hand pump	$165.00

—Cost Data—

Interest and depreciation at 16% for 20 days	$ 2.00
250 hrs. of teaming at 60c per hr.	153.60
380 hrs. of labor at 20c per hr.	76.00
Cost of water	$231.60

2. Pump and Pipe System Used; Road No. 1258, Sept. 1915.

—Investment—

Pump, 3 h.p.	$195.00
5,000-ft. of 1¼-in. second-hand pipe at .035c per foot	175.00
Tees, plugs, hose, etc.	28.00
	$398.00

—Cost Data—

Interest and depreciation at 16% for 20 days	$ 4.40
Gasoline, 45 gallons, 18c	8.10
Oil, 2½ gallons at 70c	1.57
Attendance, 15 hrs. at 25c	3.75
Connecting and taking apart pipe, 84 hrs. at 25c	20.10
Cost for water	$ 37.92

Difference in cost equals $193.78 per mile.

Inasmuch as the average season's work is about 5 miles, a saving of $968.90 per season is effected.

New Gasoline Motor-Driven Road Roller

Private citizens now may be thankful that the old-fashioned steam-roller, with its heat, its smoke and constant racket, is now being so rapidly supplanted by gasoline motor-driven

Courtesy of Popular Science Monthly.

A GASOLINE MOTOR HAS ELIMINATED THE UPRIGHT BOILER, THE STEAM AND THE NOISE OF THE STREET-ROLLER OF THE OLDER TYPES.

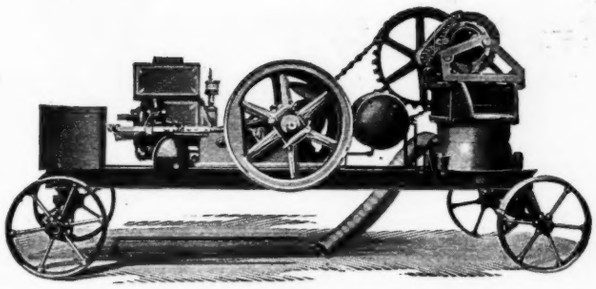
rollers which may be started at an instant's notice, have no fires to be kindled, no steam to get up and no dirty coal to carry.

When not actually in operation the motor can be shut off, whereas with the older steam type, steam must be kept on full head constantly. Further the elimination of the upright steam boiler allows the driver a far better view of his work and greatly lessens the weight on the rollers, without, however, reducing the pressure and, more than that, assuring a more steady movement of the rollers themselves.

Chain-Driven Trench Pump

Herewith is illustrated a power-driven trench pump, equipped with a sprocket-chain drive from the engine to the pump and a pump rod driven from an eccentric shaft instead of a rocker arm. The eccentric shaft is connected with the sprocket wheel shaft by a single set of gears and a compensating link attached to the connection of the eccentric with the pump rod keeps the rod in an upright position during its travels.

At the side of the pump is a 3-in. suction and a lateral discharge spout to which a chute, or trough, can be attached if



desired. All valves have openings sufficiently large to pass anything which goes through the suction hose.

The outfit as illustrated has a pump and 2-h.p. gasoline engine mounted on a steel-frame truck, the total weight being approximately 680 lb. If mounted on skids, this weight would be reduced to about 525 lb. Operating at 45 strokes per min., the capacity is from 3,500 to 4,000 gal. per min. This capacity, however, may be doubled by using a 2-pump outfit and a 3½-h.p. engine, with a total weight of 1,250 lb.

These trench-pumping outfits, as well as the gasoline engines, used in conjunction with them, are built by the Waterloo Cement Machinery Corporation, Waterloo, Ia.

Trade Notes

The city of New Orleans has changed its specifications for street pavement foundations, and brick masonry to permit the use of slag cement in the concrete, which is obtainable for 85 cents a barrel f. o. b. cars at Birmingham, Ala.

Lewis Institute, Chicago, Ill., and the Portland Cement Association will hereafter jointly operate the structural materials research laboratory at the Institute which has done much valuable work during the past 2 years.

The residents on the south side of Commonwealth avenue, Boston, Mass., think so well of bitulithic as a resurfacing for the macadam road on their half of the street that they have paid in to Mayor Curley a check for $7,990.90, the difference between the cost of bitulithic and the cost of an asphalt wearing surface, according to the lowest bid at a letting recently held. This check will protect the city in case any of the property owners refuse to pay the additional assessment of $1.25 a front foot on their property, necessary to secure bitulithic.

The Shawmut Paving Brick Works, of Shawmut, Pa., with one plant, and the Pennsylvania Clay Company, of Pittsburg, Pa., with three plants, have become licensees of the Dunn Wire-Cut-Lug Brick Company.

The John Kline Brick Company, Wickliffe, O., is the newest and the 34th member of the Dunn Wire-Cut Lug Brick Company's family of licensees. This is a well-constructed and well-managed plant with a daily capacity of 40,000. It is a progressive company that makes a high quality of bhick which has stood the test of service. Mr. J. C. Kline is president of the company and he has high repute in the business world.

The Asbestos Protected Metal Company announces that Mr. William H. Cummings, formerly of Providence, R. I., has become associated with its Waugh Glazing Department.

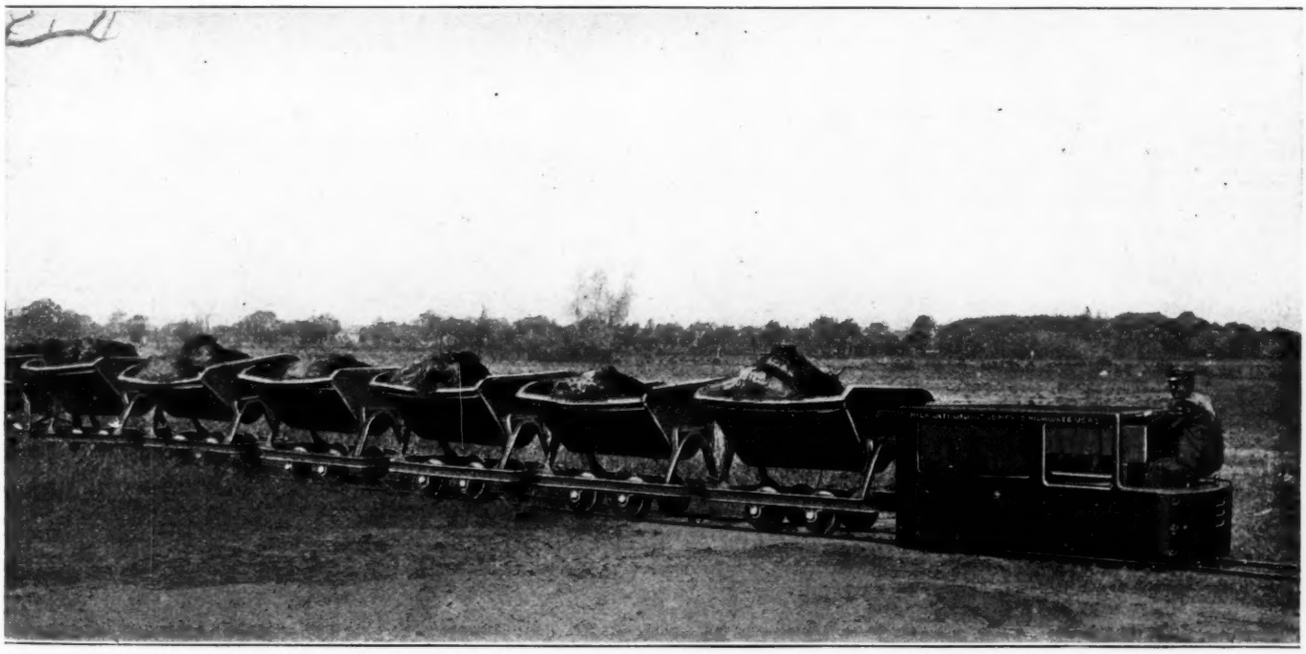
Photographers, both professional and amateur, can find a good market for a certain class of pictures by addressing the Portland Cement Association, 111 West Washington street, Chicago, and requesting details of a photographic competition which the association is now conducting. A number of cash prizes for best pictures received will be offered, in addition to which all prints received that are suitable for advertising or booklet illustrating will be purchased at a fair price. Write the Portland Cement Association for particulars.

Walter T. Sewell, sales manager of the Sewell Cushion Wheel Company, is making a trip through the east, and will visit their branches in Pittsburg, Baltimore, Philadelphia, New York, and Boston, where he will meet their branch selling organizations to discuss plans for the coming year.

Gasoline Locomotive for Contractors

The accompanying illustration shows how a certain large contracting firm (name deleted by request) is using a Type "M-20" 4½-ton, 24-inch-gage gasoline locomotive in connection with excavating and construction work. Being a self-contained unit of power and requiring only an ordinary track, this type of engine can operate successfully in districts where it is impossible to obtain power from a power plant, and where fuel and water are scarce.

The engine, which is made by the Milwaukee Locomotive Mfg. Co., of Milwaukee, Wis., is said to cost very little either to install or maintain, while its compact, simple construction especially adapts it to heavy hauling under adverse conditions.



Contracting News

AUTOMOBILE, FIRE APPARATUS & MOTOR EQUIPMENT.

CONTRACTS AWARDED.

Anderson, Ind.—Bilateral Fire Hose Co. was awarded contract for furnishing 1,000 ft. of fire hose, at $1 per ft.

Helena, Mont.—The Seagrave Company, Columbus, Ohio, were lowest bidders for furnishing city with hook and ladder truck, bid of $5,900.

Eagle Grove, Iowa—City council awarded contract for motor fire truck to Dart Motor Co., Waterloo; bid of $2,780. Other bidders were General Motor Co., $3,000; Luverne Comm. Motor Co., $2,700, and American La France, $2,750.

Sacramento, Cal.—The lowest bidders for furnishing Fire Chief Anderson with an automobile, were: Laupee Garage, $1,190; Mitchell Motor Car Co., $1,650; Lincoln Highway Garage, $2,390.

Salem, Ohio—Robinson Fire Apparatus Mfg. Co., St. Louis, sold two motor fire trucks to city. Estimated cost, $15,000.

CONTEMPLATED WORK.

Anaconda, Mont.—The purchase of a chief's car has been recommended. Chas. Collins, Chief.

Aurora, Ill.—The purchase of a chief's car has been recommended. Geo. J. Rang, chief.

Alameda, Cal.—Contemplating purchasing, next month, one comb. chmical engine and hose wagon (motor driven). W. T. Steimetz, Chief.

Ashland, Ky.—Contemplating purchasing one hose and chemical truck within one year.

Cairo, Ill.—The purchase of 60 ft. ladders and 500 ft. of fire hose has been recommended. William Gillespie, Sec'y.

Canton, Ill.—A combination chemical and hose car has been recommended. C. H. Totten, Fire Marshall.

Bellefontaine, Ohio.—The purchase of combination chemical and hose car has been recommended. H. S. Blair, Fire Chief.

Delaware, Ohio—Contemplating the purchase of combination and pump engine car. C. W. Keiser, Chief.

East St. Louis, Ill.—The purchase of truck for city service, has been recommended. M. J. Tobin, Chief.

Elizabeth, N. J.—Contemplating purchasing, within three months, three pumping engines, three combination chemical cars and four tractors. Aug. Gerstung, Chief.

Erie, Pa.—The purchase of one triple combination and two chief's cars has been recommended. J. M. Duerner, Chief.

Galesburg, Ill.—Contemplating the motorization of fire dept. John E. Cater, Chief.

Grand Junction, Colo.—The purchase of 900-gal. triple combination truck has been recommended. Expected to be purchased 1917. J. S. Hynes, Chief.

Granite City, Ill.—Contemplating purchasing, next month, one six cylinder comb. chemical and hose truck. Fred Stegelmeyer, Chief.

Great Falls, Mont.—Council recommends the purchase of a motor-drawn ladder and service truck and triple combination truck, also 1,000 ft. of 2½-in. hose. Est. cost, $12,000.

Greenwich, N. Y.—$4,000 has been voted, and $3,500 more to be appropriated, for the purchase of auto pumping engine for the Boro Fire Dept.

Greensboro, N. C.—Contemplating purchasing, within six months, two combination motor trucks. H. N. Taylor, Chief.

Holland, Mich.—Contemplating purchasing, within three months, two hose and chemical trucks, also one hook and ladder truck. C. Bloom, Jr., Chief.

Hillsdale, Mich.—Contemplating purchasing one Ford chemical truck, within four months.

Joliet, Ill.—Aerial truck and motor hose wagon to be purchasel for reserve service. C. W. Royce, Chief.

Lackawanna, N. Y.—To vote on proposed $18,000 appropriation for purchase of auto fire trucks with chemical combinations.

LaCrosse, Wis.—Contemplating purchasing, within two months, two city service trucks. The purchase of one pumper chemical hose car has been recommended. Fred C. McGlachlin, Chief.

Little Falls, N. Y.—Contemplating purchase, within 12 months, tractor for hook and ladder and two combination hose and chemical cars. Edw. J. Cooney, Chief.

Malden, Mass.—Contemplating purchasing one triple combination hose pump and chemical. The purchase of 1,000 ft. of fire hose has been recommended. J. T. Nicolls, Acting Chief.

Mattoon, Ill.——Contemplating the purchase of two combination trucks. The purchase of 1,000 ft. hose has also been recommended. J. C. Weaver, Chief.

Merrill, Wis.—The purchase of gasoline pumper with hose and chemical, has been recommended. Andrew Milspaugh, Chief.

Munvere, Ind.—The purchase of two comb. hose and chemical motor trucks has been recommended. John E. Casey, Chief.

Painesville, Ohio—The purchase of a triple combination junior pump has been recommended. T. W. Morgan, Chief.

Pana, Ill.—Triple combination chemical hose and pumper has been requested of city council. Geo. W. Searles, Chief.

Plainfield, N. J.—Contemplating purchasing, within six months, one aerial hook and ladder truck. T. D. Doane, Chief.

Poplar Bluff, Mo.—Contemplating the purchase, within the next 18 months, of combination chemical and hose and pump combined. Chas. E. Langley, Chief.

Rome, N. Y.—The purchase of one city service truck and chief's car has been recommended. Geo. M. Bower, Chief.

Shreveport, La.—The purchase of one aerial truck has been recommended. Chris. O'Brien, Chief.

Springfield, Ill.—Contemplating the purchase of one 750-gal. combination pump or a double tank combination apparatus. Peter Jacobs, Chief.

St. Louis, Mo.—A bond issue of $400,000 to motorize fire dept., is being considered.

Terre Haute, Ind.—Contemplating the purchase of two motor trucks within four months. Harry Bledsae, Chief.

Watertown, Mass.—Contemplating purchasing, within 12 months, gasoline pumper with hose and chemical. John W. O'Hearn, Chief.

BRIDGES.

BIDS REQUESTED.

Baltimore City (Cecil Co.), Md.—Until Nov. 14, 12 noon, for construction of reinforced concrete bridge over Little Elk River. Contract No. CE-23. C. C. $500. Fra. H. Zouck, Chrmn. St. Highway Comm.

Baltimore City (Charles Co.), Md.—Until Nov. 14, 12 noon, for construction of reinforced concrete bridge over Zewiah Swamp on State Road bet. Waldorf and Bryantown. C. C. $500. Contract No. 0153.

Benton Harbor, Mich.—Until November 9, for construction of steel bridge, 340 ft. long, 20 ft. wide, two 5-ft. walks. Est. cost about $19,000. Add City Council.

Cleveland, Ohio—Until Nov. 18, for construction of bridge work. (Report No. 3952.) Add. E. G. Krause, City Clerk.

Baltimore (Washington Co.), Md.—Until Nov. 14, 12 noon, for repairing bridge over Conocheague Creek on State Road. C. C. $500. Contract No. 0215. Add. Fra. H. Zouck, Chrmn. State Highway Comm.

Dayton, Ohio—Until Nov. 9, 12 noon, for construction of bridge on New Troy Pike and Springfield Rd. in Butler Twshp. Add. Co. Commrs. of Montgomery Co.

Doniphan, Mo.—Until Nov. 9, for construction of three reinforced concrete bridges over Ditch No. 2 in Ripley Co. Add. Co. Clk., Doniphan.

Des Moines, Iowa—Until Nov. 29, for construction of new concrete bridge at Grand Ave. Add. City Council.

Mitchell, S. D.—Until Jan. 1, for construction of eighteen bridges. Est. cost $20,000. Add. J. M. Crampton, Co. Aud. of Davidson Co.

Newton, Iowa—Until Jan. 1, for construction of bridges and culverts. Est. cost, $25,000. Add. C. O. Edge, Co. Audr.

Seale, Ala.—Until Nov. 15, for construction of bridge over Brush Creek in Russell Co., steel, concrete piers. Add. W. S. Keller, St. Highway Engr., Montgomery, Ala.

Tecumseh, Okla.—Until Nov. 9, for construction of two concrete bridges and one concrete culvert. Add. J. Krouch, Chmn. Co. Commrs.

CONTRACTS AWARDED.

Buffalo, N. Y.—The lowest bidders for reconstruction of viaducts in Abbott Road, were, Great Lakes Dredge & Docks Co., bid of $18,325. For Babcock Viaduct, Strobel Steel Constr. Co., bid of $44,923. For Elk Street-Abbott Rd. viaduct, Strobel Steel Constr. Co., bid of $333,274, and $45,145 for Hamburg St. viaduct.

Buffalo, N. Y.—The lowest bidders for construction of wall along Dead Creek and Ohio basin, also bascule bridge across Dead Creek, were, Buffalo, Larkin & Sangster Co., bid of $534,615.

Carbondale, Pa.—To Phoenix Bridge Co., Phoenixville, contract for construction of viaduct on Dundaff St. Bid of $50,000.

Columbus, Ohio—To Capital Constr. Co., City, contract for construction of Rich St. bridge. Bid $21,039.

Des Moines, Iowa.—The building of reinforced concrete and steel bridge, 500 ft. long, over Des Moines River. Est. cost, $150,000. Plans filed with K. O. Kastberg, Eng., City Hall.

Indiana, Pa.—To Whitaker & Diehl, Harrisburg, contract for construction of concrete bridge over Twolick Creek, including 67-ft. spans, 18-ft. roadway. Bid of $10,419.

Kankakee, Ill.—To M. & P. Constr. Co., Rockport, Ind., contract for construction of bridge across Kankakee River at Warner farm. Bid of $43,213.

Lynchburg, Va.—To M. M. Elgan, Macon, Ga., for construction of viaduct across River James and Ry. track, 1,800 ft. long, 30 ft. wide. Est. cost $350,000.

Ludlow, Ky.—To Butler & Tyler Co., Louisville, contract for construction of viaduct on Elm St. Bid of $25,751.

Marietta, Ohio—To Meridith Constr. Co., Lowell, contract for construction of viaduct between Marietta and Parkersburg. Bid of $60,000.

Narrows, Va.—To Champion Bridge Co., Wilmington, contract for construction of bridge across New River. Bid of $30,000.

Norfolk, Va.—To Laub & Stuart, Pittsburgh, Pa., contract for construction of steel bridge from Norfolk to Berkley, 2,100 ft. long. Bid of $350,000.

Pearlsburg, Va.—To Champion Bridge Co., Wilmington, Ohio, contract for construction of bridge over New River at Narrows. Bid of $30,970.

Shelby, N. C.—To Austin Bros., Dallas, Tex., contract for construction of steel bridge across Broad River. Bid of $39,800.

Simpson, Pa.—To E. Whalon, Towando, contract for construction of substructure for 850-ft. viaduct. Bid of $70,000.

CONTEMPLATED WORK.

Akron, Ohio—Plans to be prepared for construction of 2,300-ft. viaduct at North Hill Extension. Est. cost, $1,200,000. Add. E. W. Paul, Co. Engr., Summit Co.

Denver, Colo.—Contemplating constructing 2,700-ft. steel and concrete viaduct on 23d St., at an est. cost of $300,000. Add. R. W. Speer, Mayor, for information.

Crestview, Fla.—Plans completed for construction of bridge one-half mile long, over Shoal River at Millage Cox Plance crossing. Est. expenditure, $500,000.

Cincinnati, Ohio—Plans completed for construction of bridge over Mill Creek at No. Bend Rd. Est. cost, $46,000. Add. Co. Surv., William Boeh.

Ft. Wayne, Ind.—Plans being prepared by City for construction of State St. bridge. Est. cost $65,000. F. M. Randall, City Engr.

Great Falls, Mont.——Plans completel by Richard C. Schupper, City Engr., for construction of steel and cement span over Missouri River and west end of First Ave. Est. cost, $200,000.

Jacksonville, Fla.—Bridge to be constructed across the St. Johns River at Jacksonville. Est. cost, $850,000.

Johnstown, Pa.—$100,000 bond issue authorized, for construction of Luten concrete bridge between 8th and 17th wards. Add. J. R. Crissey, City Engr.

Kansas City, Mo.—Contracts to be awarded soon for construction of bridge 700 ft. long in Swope Park over Blue River. Est. cost, $160,000. Add. Waddel & Son, Engrs., 934 Wyandotte St.

Middletown, N. Y.—Footbridge and vehicle bridge to be constructed over Poughkeepsie bridge. Est. cost, $400,000.

Milwaukee, Wis.—James Pinney, Supt.